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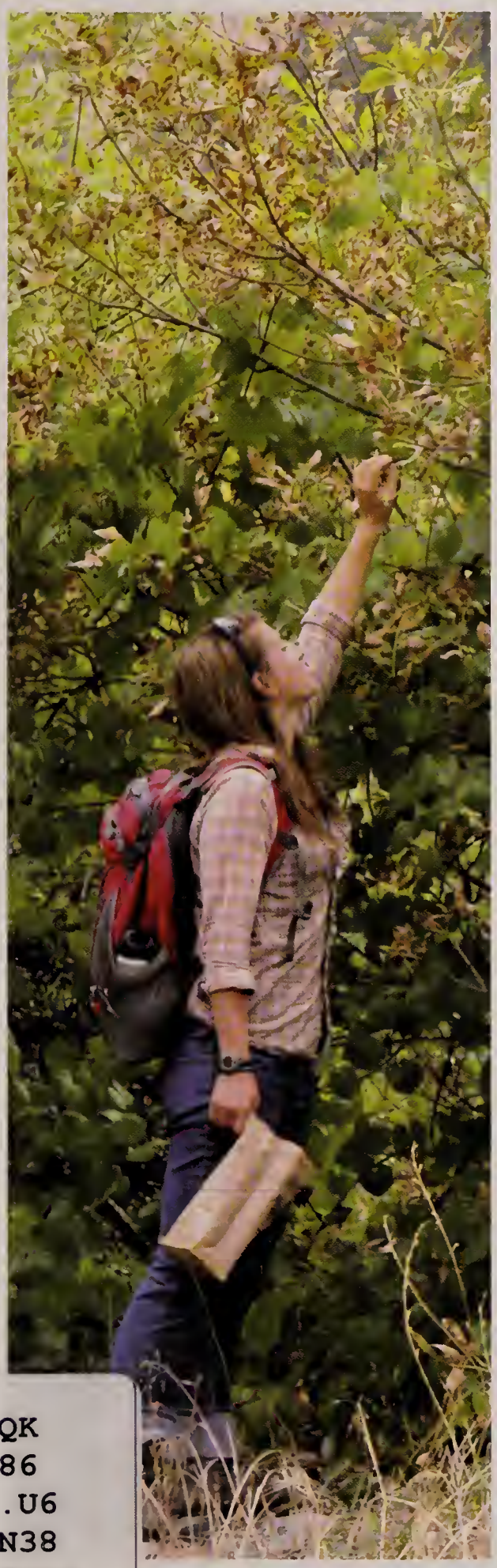
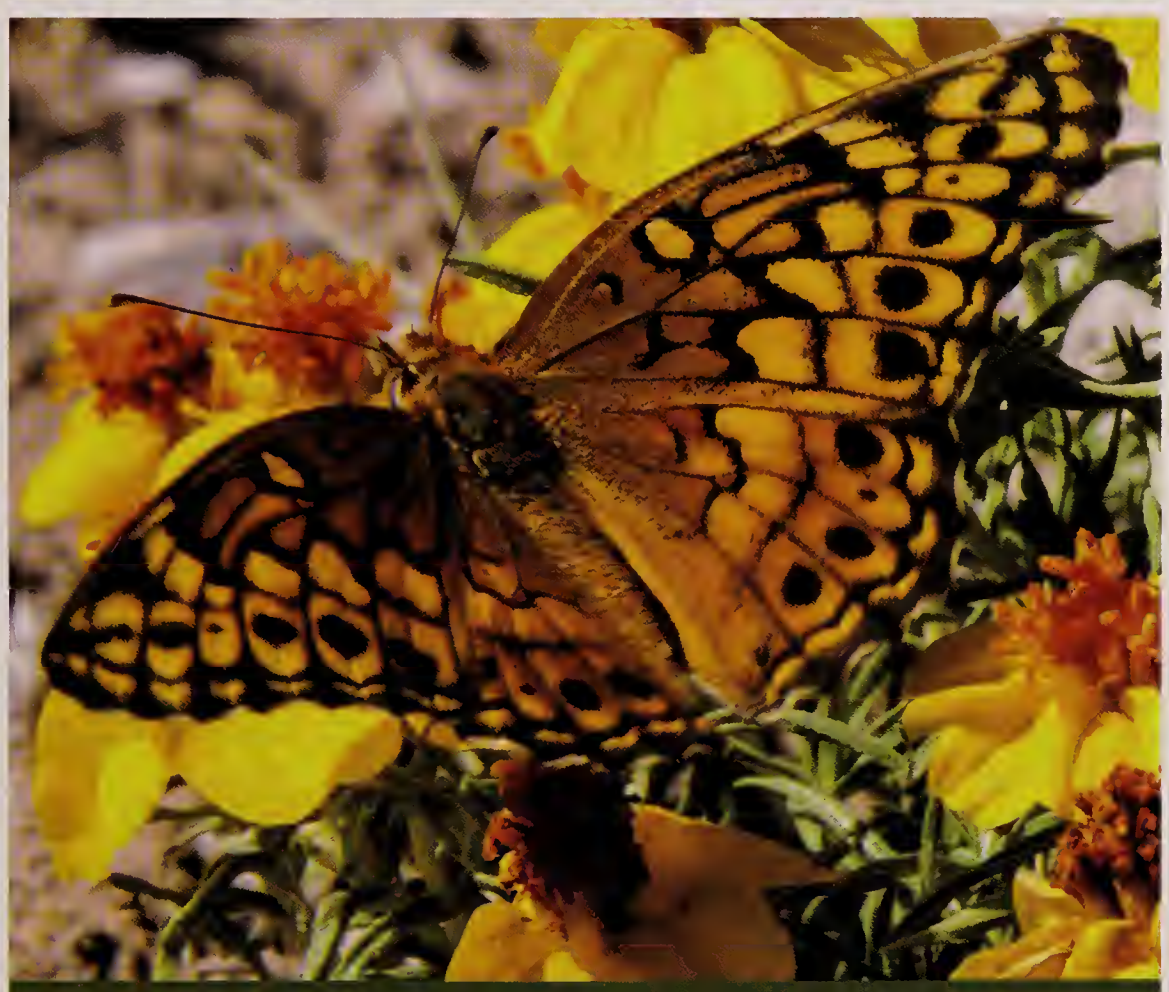
NATIONAL SEED STRATEGY



for Rehabilitation and Restoration



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plant conservation alliance

The Plant Conservation Alliance (PCA) is a public-private partnership of organizations that share the same goal: to protect native plants by ensuring that native plant populations and their communities are maintained, enhanced, and restored. The PCA Federal Committee, chaired by the Bureau of Land Management, developed the "National Seed Strategy for Rehabilitation and Restoration 2015-2020" in cooperation with Federal and non-Federal partners.

For more information on the Plant Conservation Alliance and its members and activities, please visit http://www.blm.gov/pca.

Copies of this publication may be obtained online at www.blm.gov/seedstrategy.

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INTRODUCTION

In 2012, more than 2 million acres of important sagebrush habitat burned in four Western States. In the East, Hurricane Sandy caused not only widespread damage to homes and businesses, but also to native plant communities that stabilized soils and filtered water. Three years later, many of these eastern and western lands are still in need of basic stabilization, rehabilitation, or other restoration treatments.

The "National Seed Strategy for Rehabilitation and Restoration 2015-2020" (Strategy) will provide a more coordinated approach for stabilization, rehabilitation, and restoration treatments. It provides a framework for actively working with the private sector in order to build a "seed industry" for rehabilitation and restoration. This will help address future challenges so that we, as a Nation, will be better prepared to respond appropriately to large-scale disturbances and other stressors that threaten important plant communities and the ecosystem services they provide on Federal, state, local, and private land. These stressors include the spread of invasive plant species, altered wildfire regimes, habitat modification, land overuse, and climate change.

This Strategy also provides guidance for, and implements a number of, major national initiatives, such as the President's Climate Action Plan; National Fish, Wildlife & Plants Climate Adaptation Strategy (NFWPCAP 2012); National Strategy to Promote the Health of Honey Bees and Other Pollinators (Pollinator Health Task Force 2015); Department of the Interior (DOI) Secretarial Orders 3330 on mitigation and 3336 on rangeland fire; and Executive Order 13112 on invasive species.

Success on a national scale will be achieved through coordinated establishment of a nationwide network of native seed collectors, a network of farmers and growers working to develop seed, a network of nurseries and seed storage facilities to supply adequate quantities of appropriate seed, and a network of restoration ecologists who know how to put the right seed in the right place at the right time.

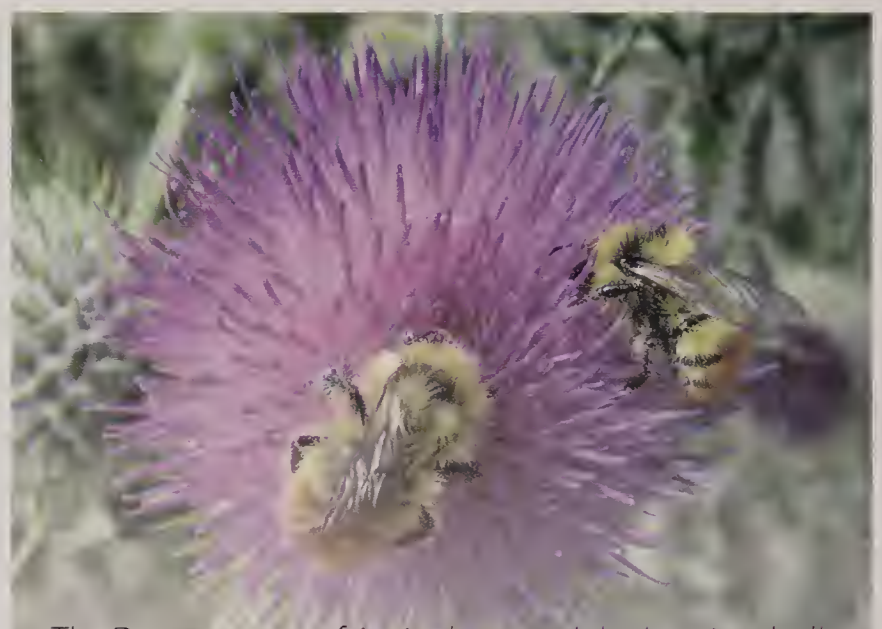
Achieving this will require additional investments, research, improved decision tools, and enhanced communication. But most importantly, successful implementation of this Strategy will require the active participation of a diverse set of public and private partners. Increased coordination is vital to accelerate the pace and scale of restoration and provide native plant materials when and where they are needed. To that end, this Strategy will help coordinate the efforts of tribal, state, Federal, local, and private entities to restore plant communities that have been altered by natural or human-caused events.

This Strategy recognizes the importance of healthy native plant communities as an essential foundation for ecosystem integrity and diversity. Healthy native plant communities create habitat for animals; provide ecosystem services that sustain people, their communities, and their economies; and have intrinsic and irreplaceable biotic value that will become increasingly important in the future.

Restoring native plant communities on a landscape scale poses special challenges. Land managers must often replant large acreages quickly to avoid severe erosion or colonization by nonnative invasive plants. Adding to the challenges are the expense and difficulty of obtaining and delivering adequate quantities of appropriate seed to meet the need, which is often difficult to predict. This seed must be available for use at the right time and in the right place.

To the extent practicable, utilize locally-adapted seeds and native plant materials appropriate to the location, conditions, and management objectives for vegetation management and restoration activities, including strategic sourcing for acquiring, storing, and utilizing genetically-appropriate seeds and other plant materials native to the sagebrush-steppe ecosystem.

SECRETARIAL ORDER NO. 3336
Rangeland Fire Prevention, Management and Restoration, January 5, 2015



The Departments of Agriculture and the Interior shall establish a reserve of native seed mixes, including pollinator-friendly plants, for use on post-fire rehabilitation projects and other restoration activities.

PRESIDENTIAL MEMORANDUM:
Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators, June 20, 2014

Great strides have been made in developing seed reserves and infrastructure to support land managers. However, there is a need for more coordinated and focused research, development, and technology transfer to provide genetically appropriate seed and seedlings for stabilizing and restoring damaged and degraded areas. Genetically appropriate plant materials are environmentally adapted to a restoration site and are likely to establish, survive, and promote community and ecological relationships. In addition, more stringent assessment is needed for determining seed quality, and seed suppliers need to be encouraged to continue producing high-quality seed in agricultural settings while maintaining genetic diversity. The use of high-quality, genetically appropriate seed, along with improved restoration equipment and methodologies, will result in more successful restoration of plant communities. The transition to a reliance on native plant materials will be guided by coordinated efforts in fundamental and applied research. This strategy envisions that the collective resources of participating agencies could support basic science needs of all the partners. In addition, new decision support tools and monitoring applications will aid managers throughout the restoration process from planning through implementation to effectiveness monitoring.

As the lead agency on the Plant Conservation Alliance (PCA) Federal Committee, the Bureau of Land Management (BLM) worked closely with the PCA and others to develop this Strategy. The goals and objectives resulted from the June 2014 Seed Conference held in Washington, D.C., that brought together Federal agency leadership. The PCA is an umbrella organization of 12 Federal agencies and more than 300 non-Federal partners who work together to conserve and restore native plant populations and communities across the United States.

This Strategy builds on the achievements and progress made through efforts such as the BLM's interagency Native Plant Materials Development Program (including Seeds of Success), the U.S. Forest Service's Native Plant Restoration Program, the Natural Resources Conservation Service's Plant Materials Program that includes 27 plant materials centers from Hawaii and Alaska to New Jersey and Florida established in 1935 to address the needs described in this strategy, the Agricultural Research Service's National Plant Germplasm System, and other public/private efforts to conserve native plant diversity.

The PCA Federal Committee is developing a business plan to accompany this Strategy. This

business plan will not create a government-run seed business. It will include anticipated costs of Strategy implementation so that Federal partners can develop an interagency budget initiative and so that non-Federal partners can determine opportunities to raise non-Federal funds to support the Strategy's work.

Scope

This Strategy is national in scope and engages both Federal and non-Federal partners working toward restoration on public, tribal, state, municipal, and private lands. While the Strategy will be renewed in 5-year cycles, its actions will affect landscapes and habitats far into the future. The plants of interest are forbs (wildflowers), shrubs, and grasses that are used in ecological restoration. The Strategy does not address federally or state-listed species, rare endemic plants, or commercial timber species. Products and collaborations developed through the Strategy will help land managers select appropriate plant materials to use in public and private ecological restoration efforts at all scales.

The Strategy aims to provide all land managers—Federal, tribal, state, county, private, and nongovernmental organization—the tools they need to address ecological restoration across the United States. The Strategy seeks to develop seed and other plant materials[1] that will meet long-term goals to maintain and improve the biological and physical conditions at a site, ranging from reclamation to restoration. Use of genetically appropriate plant materials is encouraged; however, this Strategy does not preclude the use of nonnative plant materials where they are appropriate.

With almost 30 percent of U.S. lands under Federal management, this Strategy encourages large-scale habitat restoration on Federal lands; however, smaller scale restoration will benefit from large-scale public investment in commercial native seed production. Ultimately, this Strategy will benefit U.S. landscapes by recognizing and supporting the ecosystem services provided by plant communities such as clean air, clean water, temperature regulation, and carbon storage. The Strategy also supports additional benefits of healthy plant communities such as aesthetics, recreational opportunities, food, fiber, and potential commercial products, as well as habitat for other organisms and species, from pollinators to game species.

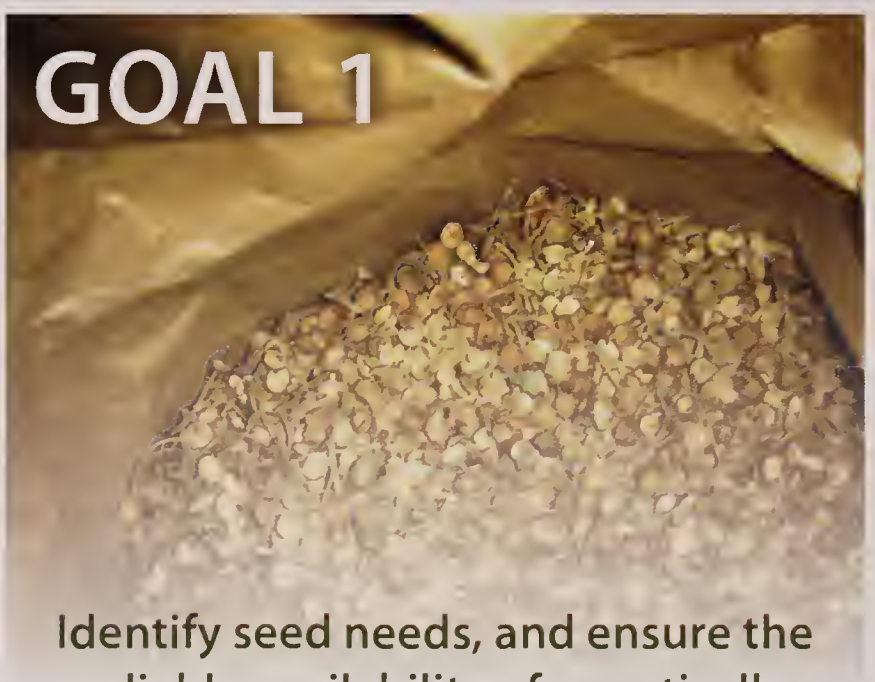
One outcome of the Strategy is the creation of a national network of native seed reserves and storage facilities (Federal, tribal, state, local, and private facilities) that would serve all partners and provide storage capabilities. This network would support the 2014 Presidential Memorandum on pollinators and help increase the availability of native seed to a broader user base.

This Strategy does not set agency policy—many agencies have different authorizing legislation or charters, missions, and policies—but it supports the science and values the use of native plant materials in land management activities.

[1] The term "plant materials" encompasses seed as well as other plant materials, including seedlings and container stock.

THE FOUR GOALS

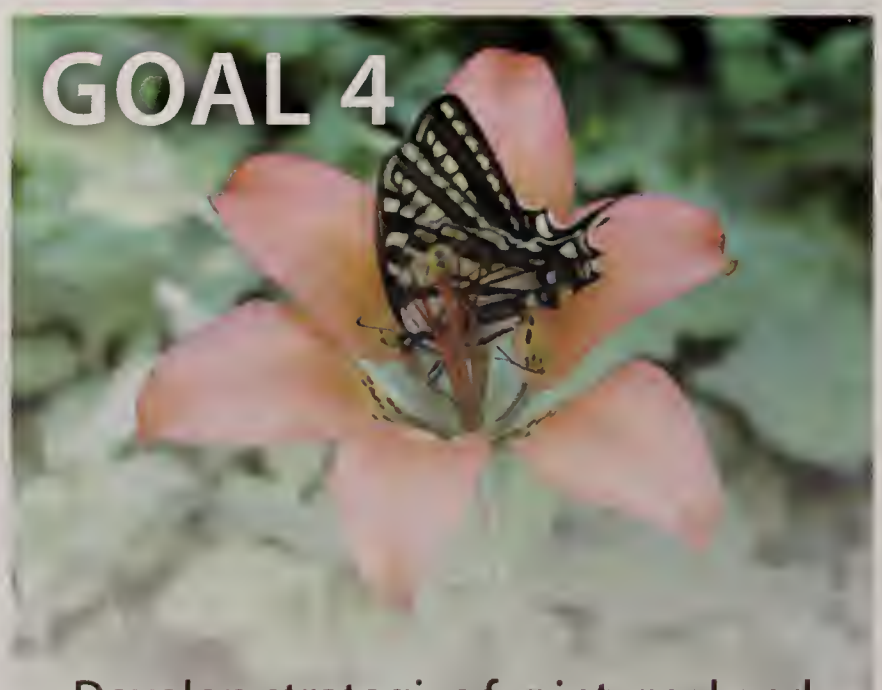
of the "National Seed Strategy for Rehabilitation and Restoration"



Identify seed needs, and ensure the reliable availability of genetically appropriate seed.

Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration.

Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration.



Develop strategies for internal and external communication.

Native plant communities, especially those containing perennial native grasses and forbs essential to ecosystem integrity and diversity, provide ecosystem services that sustain wildlife, such as greater sage-grouse and native pollinators. Perennial grasses are the best competitors with invasive annual grasses and promote resilience. A reliable supply of genetically appropriate and locally adapted seed, as well as seeding technology and equipment, is needed for effective restoration of the sagebrush-steppe ecosystem.

"An Integrated Rangeland Fire Management Strategy," Final Report to the Secretary of the Interior, May 2015

BACKGROUND AND DEVELOPMENT

The critical shortage of native plant materials available for seeding following the extensive wildfires of 1999 and 2000 led Congress to direct the BLM and U.S. Forest Service to facilitate development of a long-term program to provide a stable and economical supply of native plant materials for restoration and rehabilitation efforts on public lands (USC HR 2000). The U.S. Forest Service and BLM responded to this by establishing the Native Plant Restoration Program and the Native Plant Materials Development Program. The immediate focus was to increase the availability of diverse native plant materials and to foster more efficient management of that supply.

The fiscal year 2002 House report on appropriations for the Department of the Interior (USDI) and related agencies reiterated Congress' order to the agencies to "continue to implement the long-term program to manage and supply native plant materials for use in various Federal land management restoration and rehabilitation needs" (USC HR 2001). In April 2002, the DOI and U.S. Department of Agriculture (USDA) issued the "Report to the Congress: Interagency Program to Supply and Manage Native Plant Materials for Restoration and Rehabilitation on Federal Lands" (DOI & USDA 2002), which called for a commitment to native plant materials research, production, and use that included a recommendation for financial and organizational support from the DOI and USDA. In this report, the DOI and USDA also stated their intent to improve and expand partnerships in cooperation with the private seed and nursery industry, develop and enhance science delivery to practitioners, and expand outreach and education to the general public.

The agencies have made great achievements since establishing the Native Plant Materials Development Program and Native Plant Restoration Program. For example, provisional and species-specific seed zones are increasingly being used to guide the selection of genetically appropriate seed for ecological restoration projects, thereby increasing the potential for success (Rogers and Montalvo 2004; Johnson et al. 2010). The National Vegetation Classification, adopted by the Federal Geographic Data Committee, provides a standard approach to describe plant species assemblages throughout the Nation in the full range of environmental settings (FGDC 2008). Seed production research has provided agricultural practices for growing a wider array of restoration species, while improved equipment, seeding and planting technologies, and decision tools provide users with greater flexibility when dealing with complex seeding mixes and site conditions (DOI BLM 2009). Importantly, Seeds of Success collection teams have made more than 15,000 native seed collections covering more than 5,000 taxa for use in developing native seed crops and ex situ conservation (Haidet and Olwell 2015).

Multiple agencies (Federal, state, tribal, and local), nongovernmental organizations, private sector industries, and universities are collaborating through ecoregional programs to provide plant materials suitable for restoration in specific ecoregions. The Great Basin Native Plant Project led by the U.S. Forest Service and BLM, for example, was established in 2002 (Shaw et al. 2012). Its goal is to increase seed availability and develop the knowledge and technology to restore native plant communities across millions of acres of burned lands, with a focus on restoring native sagebrush habitat and increasing native forb production. Partners in the Colorado Plateau (Wood et al. 2015), Mojave Desert, and Pacific Northwest (Riley et al. 2015; Erickson 2008) are conducting similar programs. Through BLM ecoregional programs alone, seed from more

than 200 native plant populations have been made available for restoration projects, conservation gene banking, and commercial markets (DOI BLM 2009). To ensure coverage across the United States, these or similar programs will need to be established in areas of the U.S. where they currently do not exist.

Achievement of the long-term goals of the Native Plant Materials Development Program will require an even greater commitment to collaboration across agencies and with other partners to share expertise and facilities and to produce and use plant materials more efficiently. Leaders of the 12 Federal agencies of the PCA met in Washington, D.C., in June 2014 to celebrate 20 years of plant conservation collaboration and to renew the memorandum of understanding that established the partnership. The meeting provided a forum for agency leaders and staff to initiate discussions on development of a national seed strategy to address long-term goals for the program. The PCA Federal Committee served as the steering committee for this Strategy. Members of this committee, or their representatives, worked with agency experts on the seed supply, research, decision tools, and communication teams to further develop priority objectives under the four goals and collaborative actions for accomplishing these objectives and to better describe outcomes.

Implementation of this Strategy will enhance coordination and forge strong partnerships among agencies, tribes, states, and nongovernmental organizations, as well as with the private seed and nursery industry. Such partnerships are vital to the success of ecological restoration efforts throughout the United States.

STRATEGY
VISION AND MISSION

Vision

The right seed in the right place at the right time.

Mission

To ensure the availability of genetically appropriate seed to restore viable and productive plant communities and sustainable ecosystems.

GUIDING VALUES AND PRINCIPLES

- Native plant communities provide ecosystem services that sustain people, communities, and their economies.

- Native plant communities are key to ecosystem integrity and resilience, and they provide essential habitat and food sources for wildlife, including pollinators.

- Native plant communities have intrinsic and irreplaceable biotic value that will become increasingly important in the future.

- Native seed is a critical natural resource asset that deserves greater recognition in light of the ecological challenges of the 21st century.

- Native, locally adapted seed sources are vital for restoration and management because they reflect the evolutionary and adaptive capability of plants in an area.

- Native plants, including crop wild relatives, contain unique properties, and the full benefit of these may not yet be recognized but should be preserved for future generations.

- Botanical, ecological, and genetic scientific expertise plays a vital role in providing information to support and guide ecological restoration.

- Nonnative species and cultivars may be used to achieve site stabilization, wildfire breaks, or invasive plant control. Their use should be limited to transitional, noninvasive species, replaced by natives in subsequent ecological restoration or during natural successional processes.

- Interagency collaboration is essential to advance ecological management and research activities, reduce costs, and avoid duplication.

- Non-Federal partners, such as tribes, states, and private sector and nonprofit organizations, make important and valuable contributions to the development of native seed.

- The Strategy recognizes the value of using the native seed bank that exists in the soil; not all disturbances require active reseeding to restore habitat.

- The Strategy recognizes the value of partnering with a diverse group of stakeholders.

- Strategy participants support opportunities to:

  - Maintain or increase the number of acres of native plant communities that provide ecosystem services.

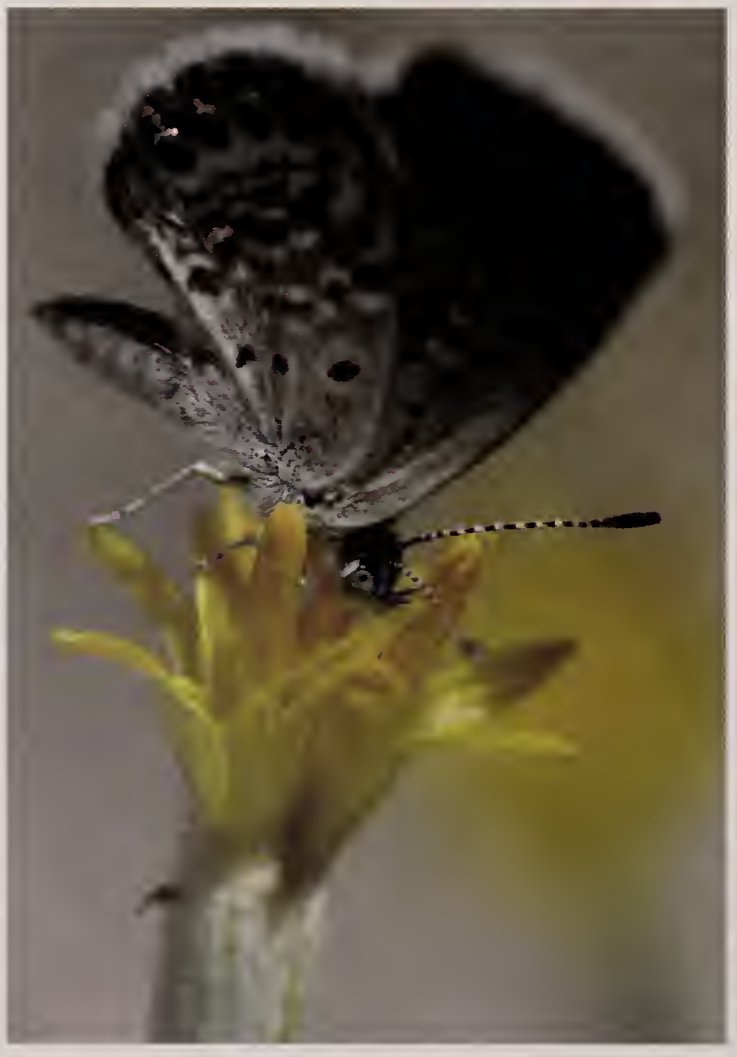
  - Include Federal, tribal, state, and local governments; academic institutions; nonprofits; and the private sector when addressing restoration issues.

  - Improve the availability of genetically appropriate seed required to restore healthy native plant communities and support other uses.

  - Develop strategies and tools for conducting more effective restoration.

  - Promote research, science delivery, and education required to meet new restoration challenges imposed by increasing threats.

  - Communicate the value of native plant communities and restoration to stakeholders and the general public.



GOAL 1

Identify Seed Needs, and Ensure the Reliable Availability of Genetically Appropriate Seed

Background/ Rationale

The ability of land managers to respond effectively to both emergency and planned restoration needs—and to advance ecological management and research activities—is highly dependent on the reliable availability of genetically appropriate seed. This requires comprehensive and integrated seed planning and production, as well as seed storage systems that provide sufficient quantities of suitable plant materials when and where they are needed. Actions under this goal will assess seed needs and fulfillment capacities, with an eye toward targeting infrastructure investments, increasing coordinated wildland seed collection and field production, and expanding cooperation and partnerships within and among public and private sectors. Increased financial and organizational support for achieving this work is essential, as is coordinating and communicating with the private seed industry. A number of actions in Goal 1 will inform actions in Goals 2 and 3.

Objective 1.1

Assess the Seed Needs of Federal Agencies and the Capacity of Private and Federal Producers

Increasing Federal agency use of native conservation seed will stimulate seed supply and also help smaller organizations and private landowners access more native plant materials. Actions under this objective will lead to a better understanding of the overall capacity of Federal agencies to meet their stabilization, rehabilitation, and restoration needs with native plant materials. The assessment will capture those needs that relate to current priorities for pollinators and climate change adaptation, as well as projections for both planned restoration and emergency response. After the initial baseline assessment, agencies may repeat a revised needs and capacity assessment every 5 years to provide measures of progress and inform priorities over time as recommended under Objective 4.3 (Report Progress, Recognize Achievements, and Revise Strategy).

This objective also aims to evaluate existing databases and reporting systems that can contribute to the seed needs and capacity planning processes. In the long-term (beyond 5-year timeframe), this objective will seek to assess the conservation value of existing collections (i.e., the genetic diversity captured by current accessions) and take steps to correct deficiencies.

Action 1.1.1 Conduct an assessment of seed needs for all Federal agencies and their offices that provide or use seed.

This assessment will capture the types and quantities of seed each Federal agency needs on an ecoregional basis for its restoration projects, including those targeting pollinator habitat enhancement to comply with the Presidential Memorandum on pollinators. Agencies should seek to include all relevant program areas and field offices that provide or use seed.

TARGET YEARS: 2015-2016
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service
OTHER PARTICIPANTS: Connecticut Department of Energy and Environmental Protection – Natural Diversity Data Base

Action 1.1.2 Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.

This action will identify existing agency seed supplies and related staff, nurseries, storage facilities, tools, equipment, and costs. It will seek information specifically on seed supplies that help resist nonnative plant competition and that provide habitat for at-risk species, including pollinators. It will also identify strengths and weaknesses in seed production and facilities networks and needs for new infrastructure, staffing, and training. Production and facilities networks include nurseries, seed extractories, plant materials centers, and seed production and storage facilities, some of which may be held by non-Federal partners (see Action 1.2.1).

Within this action, agencies will identify policies, guidance, or publications that inform management practices for seed collection and production methods. Within the second year of implementing this action, Strategy implementers will have identified and catalogued agency infrastructure and will have evaluated databases and reporting systems for seed use, seed inventory, and field performance monitoring.

TARGET YEARS: 2015-2016
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service
OTHER PARTICIPANTS: Connecticut Department of Energy and Environmental Protection – Natural Diversity Data Base

Action 1.1.3 Identify existing Federal seed and restoration policies and guidance.

This action will ensure that the Strategy captures all current Federal policies related to development and use of plant materials and restoration. Outputs for this action will include identification of plant and restoration policy compatibilities, gaps, and challenges across Federal agencies. This action provides information for actions in Goal 4, as well.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined

Action 1.1.4 Analyze results of needs and capacity assessment to determine if current Federal policies, seed collections, and storage and production facilities meet agency needs.

Reviewing results to determine strengths and correct weaknesses in Federal seed systems should lead to specific actions to improve proactive short- and long-term planning capabilities and to ensure agency staffing can respond to projected restoration needs within the third year of implementing the Strategy. Seed and capacity needs could be prioritized by habitat (e.g., for species such as pollinators and sage-grouse) and/or by seed zone.

Other results of this action would include the creation of a map of agency production and storage facilities, the evaluation of investment needs and seed use policies, and the discussion of concerns and benefits related to the use of native

plant materials. Actions to address deficiencies should be incorporated under actions identified under Objectives 1.2 and 1.3, and other goals, as appropriate.

TARGET YEARS: 2016-2017
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: Institute for Applied Ecology

Action 1.1.5 Analyze results of assessment of restoration policies, and develop a comprehensive restoration program with consistent funding to restore native plant communities on a landscape scale across public lands.

Using the output from Action 1.1.3, review results of assessment of restoration policies to determine strengths and correct weaknesses in Federal restoration policies and to determine agency staffing so they can respond to projected restoration needs within the third year of implementing the Strategy. Other results of this action would include the development of a restoration program with consistent funding to consistently buy native seed for restoring native plant communities on a landscape scale. Actions to address deficiencies should be incorporated under actions identified under Objectives 1.2 and 1.3, and other goals, as appropriate.

TARGET YEARS: 2017-2018
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service
OTHER PARTICPANTS: NatureServe

Objective 1.2

Assess Capacity and Needs of Tribes, States, Private Sector Seed Producers, Nurseries, and Other Partners

To achieve this objective, agencies will work with tribal, state, private sector, and nonprofit partners and agricultural extension offices to assess non-Federal-sector interest in and capacity to collect and produce native seed. Results of this objective may lead to expanded contractor pools, changes in contract specifications and timelines to minimize risk and uncertainty, creation of an annual seed forum, or the organization of field tours to grower farms. Accomplishing this objective may require identifying a regional liaison to work with farmers and seed producers to provide mechanisms for regular communications regarding Federal seed needs, to assist with equipment needs, and to help producers navigate the Federal procurement system.

Action 1.2.1 Conduct a needs and capacity assessment of tribal, state, local, private sector, and nonprofit seed storage and distribution facilities.

This assessment will capture the seed production and storage capacity of non-Federal entities. This action will require collaboration with partners who can work with key sectors to obtain the necessary information. Guidance developed to implement this action should also elicit information on growers' expertise and ability to provide training about tools, techniques, and capacity for seed collection; germination; and establishment of native plant communities. This assessment can also elicit information on states' capacities to certify location and origin, and it should gather information on procurement processes. Upon obtaining collaborator input, discrete milestones should be identified for anticipated achievements within each of the first 5 years of implementing the Strategy.

TARGET YEARS: 2015-2020

COORDINATING AGENCIES: Bureau of Indian Affairs, Natural Resources Conservation Service
OTHER PARTICIPANTS: American Seed Trade Association, Botanic Gardens Conservation International, Florida Association of Native Nurseries, Lady Bird Johnson Wildflower Center, Mid-Atlantic Regional Seed Bank, New England Wild Flower Society

Action 1.2.2 Work collaboratively with private seed producers, nurseries, and other partners to leverage strengths and address deficiencies in the distribution and availability of genetically appropriate seed.

This action will identify training needs and opportunities, such as working with seed producers to assist with smaller scale, niche market seed production. This action should also explore promoting a seed market system that is responsive to regional native seed needs of the agencies (see Objective 1.3). This action should result in a regular assessment of collaboration efforts that can be summarized and shared. Outcomes under this action might include identifying mechanisms to increase collaboration by 2017 and to overcome any barriers to collaboration with the private sector by 2020.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service
OTHER PARTICIPANTS: American Seed Trade Association, Applied Ecological Services/Taylor Creek Restoration Nurseries, Botanic Gardens Conservation International, Florida Association of Native Nurseries, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, Mid-Atlantic Regional Seed Bank, NatureServe

Action 1.2.3 Analyze results of non-Federal needs and capacity assessment to determine if current seed collections, as well as storage and production facilities, meet restoration needs.

Reviewing results to determine strengths and challenges in non-Federal seed systems will lead to a better understanding of the non-Federal seed system capabilities. This review can inform agencies on how they could work with non-Federal partners to improve availability of seed in non-Federal systems.

Actions to address deficiencies should be incorporated under actions identified under Objective 1.3, and other goals, as appropriate.

TARGET YEARS: 2016-2017
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: Botanic Gardens Conservation International, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center

Objective 1.3

Increase the Supply and Reliable Availability of Genetically Appropriate Seed

The actions under this objective will require an analysis of the seed needs and capacity assessments completed under Objectives 1.1 and 1.2. Achieving these actions should include setting goals for increasing collection, cleaning, testing, storage, and application capacity. Accordingly, implementation needs should set goals for achieving these milestones under each action.

Action 1.3.1 Expand and improve facilities and plant production capacity.

This action draws from the capacity and needs assessments and will result in adequate facilities, seed reserves, and plant production capacity to meet seed needs. It will target expansion and improvement of Federal and non-Federal capacity and will also encourage the commercial seed industry to enhance capacity, if necessary. This may include new processes to streamline planning and increase coordination for collecting, propagating, and sharing seed among the agencies, possibly through a memorandum of understanding by 2020.

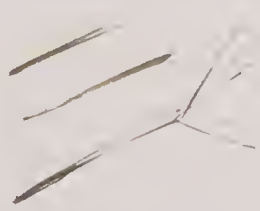
TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: American Seed Trade Association, Chicago Botanic Garden, Florida Association of Native Nurseries

Action 1.3.2 Improve agency and partner capability to plan for seed needs by seed zone.

This action will increase planning and coordination by agencies and external partners in collecting, propagating, procuring, and sharing plant materials by seed zones and will increase the use of genetically appropriate seed in both emergency and planned restoration. This action will build upon research emanating from other Strategy actions, such as Action 2.1.1 (Conduct genetic research to develop seed zones for key restoration species.), and may include coordinating multiagency procurement planning and seed sharing, where appropriate.

Existing regional seed banking networks between growers and end users, such as the Deschutes Basin Native Plant Seedbank, U.S. Forest Service Northern Region seed cache, and Mid-Atlantic Regional Seed Bank, may serve as models for accomplishing this goal. This action should include considerations for creating (or improving) a national online database that provides source-identified seed availability. Note: Some databases already exist, as informed by Action 1.1.1.

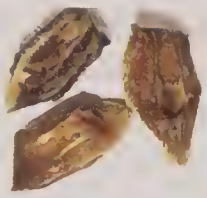
TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: Chicago Botanic Garden, Florida Association of Native Nurseries, Mid-Atlantic Regional Seed Bank, New England Wild Flower Society



Action 1.3.3 Assess and implement alternative seed production methods for "workhorse" shrub species to augment wildland seed collection.

This action aims to increase the supply of genetically appropriate shrub seed. Alternatives might include creation of shrub orchards (e.g., sagebrush or bitterbrush) or protection of wildland or private land stands for commercial seed harvesting. Best management practices may need to be developed to preclude damage to wildland populations.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: Chicago Botanic Garden, Lady Bird Johnson Wildflower Center



Action 1.3.4 Expand collection, conservation, and assessment of native plant genetic resources for use now and into the future through Seeds of Success and other complementary efforts.

This action will lead to field collections of seed that represent the genetic diversity of species populations for use in seed zone development, seed production, restoration, research, breeding, and conservation. It will include training collection teams on seed collection methods to ensure the genetic diversity within species is collected. The outcome would be the conservation, assessment, and distribution of genetic resources for research purposes through the Agricultural Research Service's National Plant Germplasm System (and other agencies and institutions) and restoration purposes through regional seed banks, such as the Mid-Atlantic Regional Seed Bank.

This action will also identify in situ reserve areas important for native plants, such as wilderness areas and research natural areas. It would include improving agency permitting for seed collection on Federal lands, writing best management practices for seed collection, and potentially developing programmatic National Environmental Policy Act documents to streamline the permit process, where needed.

This action may consider whether or how to prioritize germplasm collection for species based on potential use (e.g., crop wild relatives) and rarity, including salvage of seed material prior to activities that will damage the landscape. One tool resulting from this action could be a database that tracks seed collection sites on Federal lands.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, Smithsonian Institution, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: American Public Gardens Association, Botanic Gardens Conservation International, Chicago Botanic Garden, Denver Botanic Gardens, Lady Bird Johnson Wildflower Center, NatureServe

Action 1.3.5 Engage Federal procurement specialists to assess current contracting regulations and practices to identify strengths and take actions to correct deficiencies.

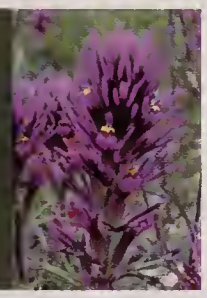
This action should explore how existing procurement practices (e.g., reacting to fires) may contribute to price fluctuations and seed demand due to unpredictability in wildfires and other impacts to the land. This action should result in improved mechanisms for coordination and communication between the Federal Government and the commercial seed industry to encourage the commercial seed industry to meet seed needs (e.g., indefinite delivery/indefinite quantity contract, blanket purchase agreement, permitting practices). Additional deliverables under this action may include developing a planning framework to deliver seed for emergency stabilization and burned area rehabilitation and providing training to small business owners on navigating the Federal procurement system. Strategy implementers can also examine procurement staffing and training needs under this action.

TARGET YEARS: 2015-2017
COORDINATING AGENCIES: Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: American Seed Trade Association, Florida Association of Native Nurseries, Institute for Applied Ecology, Mid-Atlantic Regional Seed Bank

GOAL 2

Identify Research Needs and Conduct Research to Provide Genetically Appropriate Seed and to Improve Technology for Native Seed Production and Ecosystem Restoration

Background/ Rationale

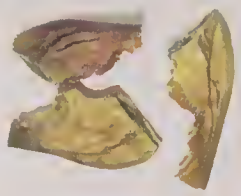


The use of native plants to restore disturbed communities is essential to provide diversity, improve ecosystem functioning, facilitate adaptation to climate change, and meet management objectives. To ensure that adapted plant materials are available to provide long-term sustainability, additional research is required. This includes developing and testing seed zones; developing reliable protocols for seed testing, storage, and production; and defining effective restoration strategies and monitoring systems. Under the following objectives and actions, agencies will assess research priorities in each of these areas in order to provide the knowledge, plant materials, and technology essential for conducting fully functioning plant materials programs where needed. Accomplishing these actions will entail collaboration among managers, scientists, seed regulatory agencies, and the private sector seed industry. It will be essential to have agency support for targeted research projects. Outcomes of research will contribute to development of decision tools as described in Goal 3.

Objective 2.1

Characterize Genetic Variation of Restoration Species to Delineate Seed Zones, and Provide Seed Transfer Guidelines for Current and Projected Future Environmental Conditions

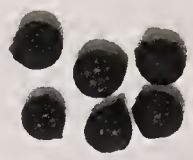
Because seed zones and seed transfer guidelines are lacking for most noncommercial species, research is urgently needed to aid managers in selecting genetically appropriate seed materials for restoration. Improving plant material availability entails collaboration among land managers within ecoregions, seed zones, mapped vegetation types, or other biogeographical areas to identify key restoration species, including those currently in use, and additional species required to meet restoration and management goals. Actions within this goal will foster the research needed to further refine climate-based provisional seed zones used for the many species for which genetic data is lacking. For widespread, commonly used restoration species, studies of genetic variation are required to develop empirical seed zones and seed transfer guidelines. Models based on these research results can be used to predict climate change effects on plant distributions and inform restoration efforts.



Action 2.1.1 Conduct genetic research to develop seed zones for key restoration species.

Key restoration species collaboratively identified by managers and researchers will determine priorities for the development of empirical (species-specific) seed zones. For these species, this would entail common garden and reciprocal transplant studies to identify adaptive plant traits for use in empirical seed zones.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, National Institute of Food and Agriculture, Natural Resources Conservation Service/Plant Materials Centers, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Botanic Gardens Conservation International, Chicago Botanic Garden, Denver Botanic Gardens, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, Mid-Atlantic Regional Seed Bank, NatureServe, New England Wild Flower Society, Utah Department of Natural Resources, universities



Action 2.1.2 Develop predictive models of climate change effects on target restoration species and genetic diversity using 20-year or mid-century climate models.

Predictive models of climate change effects are used to assess threats to important restoration species and opportunities for targeting, prioritizing, and implementing restoration projects in light of potential changes in species distributions and community composition. Models will identify changes in species distributions and seed zone boundaries that will aid in identifying potential refugia areas, bottlenecks to species' movement, and selection of appropriate populations for inclusion in restoration projects to reduce the risk of future maladaptation.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: National Institute of Food and Agriculture, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: American Public Gardens Association, Chicago Botanic Garden, Institute for Applied Ecology, NatureServe, universities,

Objective 2.2

Conduct Species-Specific Research to Provide Seed Technology, Storage, and Production Protocols for Restoration Species

Reliable species-specific protocols are required for evaluating seed quality and maintaining viability of seed in storage if seed reserves are to be available when needed. Similarly, guidelines for producing seed of restoration species, particularly native forbs, in agricultural settings are required to reduce economic risks to growers. Accomplishing this action will require that research needs be identified and prioritized by users, growers, seed analysts, and others and communicated to seed technologists and agronomists having appropriate areas of expertise (e.g., seed biology and technology, crop science, pollinator biology, soil science). Federal liaisons to private sector growers, as recommended under Objective 1.2, could provide coordination for this process. Outcomes will include additions to the Association of Official Seed Analysts (AOSA) Rules for Testing Seeds, guidance for construction of regional and local storage facilities, and improved equipment and technology for native seed production. Resolution of information gaps and production bottlenecks is often essential to expanded and economical production and use of individual species.

Action 2.2.1 Conduct seed germination studies and develop seed testing protocols for key restoration species.

This action will support research to determine the germination biology and provide the AOSA-accepted seed testing protocols for commonly seeded restoration species, as well as species in demand but not currently in use. Publications on germination biology and ecology for these species will be reviewed. Knowledge gaps will be identified and prioritized by managers, growers, and researchers. The resulting research will inform seeding practices (e.g., requirements for dormancy release, seed

pretreatments, seeding rates, dates, depths) for seed production fields and wildland seedings. Studies designed to formulate standardized germination testing procedures for individual species are refereed by AOSA prior to acceptance into the Rules for Testing Seeds. Close coordination with the AOSA Native Seed Testing Committee is required to schedule referee testing. The rules are used by certified seed laboratories across the country to increase uniformity in results. Standardized testing procedures are needed to evaluate seed lot quality. Outcomes of this action and existing data will be synthesized and compiled in existing or new databases.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, private seed testing laboratories and seed companies, state seed laboratories, universities

Action 2.2.2 Develop storage guidelines for restoration species to improve maintenance of seed viability.

This action aims to provide species-specific requirements needed to manage stored seed supplies and conserve seed quality. Seed handling and management protocols to maintain viability from harvest through conditioning, storage, and use are lacking for most restoration species. Optimal temperature and relative humidity requirements to maximize seed longevity in storage have rarely been identified. Although many restoration species can be stored successfully in warehouses under ambient conditions for short periods, others lose viability rapidly, resulting in lost profits to growers or lost reserves to users. Available database information, literature, storage records, and observational reports will be reviewed on a regional or seed zone basis to identify problematic species and prioritize research. Public and private researchers, including certified seed laboratory personnel, will be solicited to conduct required studies. Response may be limited due to the long-term nature of the research and availability of suitable facilities and equipment for conducting the studies. Products and publications will include storage protocols, expanded seed technology databases and synthesis documents.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, Great Basin Research Center, private seed testing laboratories and seed companies, state seed laboratories, universities, Utah Department of Natural Resources

Action 2.2.3 Develop species-specific protocols for seed and seedling production practices that maintain genetic diversity.

This action fosters research needed to aid growers in producing seed crops and nursery seedlings efficiently and economically while maintaining genetic diversity. Bottlenecks to successful production often appear when wildland species are grown as monocultures in seed fields or nurseries. Review of seed needs assessments by ecoregion or seed zone, combined with an examination of pertinent literature; databases; and surveys of growers, nurserymen, and researchers, is needed to identify obstacles to the successful production of individual species. Regional liaisons may be required to aid in prioritizing and expediting research. Scientists with expertise in improving stand establishment, weed control, irrigation, pollinator management, plant pathology, root and soil microorganisms and facilitators, and a wide array of other disciplines may be called upon to resolve specific problems. Input from geneticists is required to set guidelines for maintaining genetic diversity from seed collection through seed conditioning and seed or seedling production. Outcomes of this work, in addition to seed supplies and nursery seedlings, will include publications, technical notes, databases, webinars, workshops, and field days.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, National Institute of Food and Agriculture, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, public and private seed producers and nurseries, state agencies, universities

Objective 2.3

Conduct Research on Plant Establishment, Species Interactions, and Ecological Restoration

Increasing the use of native species requires greater knowledge of requirements for seedling establishment, species interactions (among natives and between natives and nonnatives), and more effective strategies for conducting restoration in ecological settings ranging from wetlands to semiarid landscapes. Actions under this objective will encourage collaboration among agency personnel, private sector seed industry and restoration contractors, and Federal and non-Federal scientists to prioritize research needs by plant community. Although studies of seedling establishment and species interactions may be completed within the 5-year timeframe, restoration research will be long term, collaborative among all involved parties, and interdisciplinary. Research outcomes will be reported through publications and also transmitted to users via tools described in Objective 3. It is expected that outcomes may indicate a need for added agency support, personnel trained in restoration ecology, and investment in infrastructure.

Action 2.3.1 Develop site preparation and seeding and transplanting strategies that improve plant establishment and community diversity.

This action will identify issues limiting successful restoration and prioritize needed research activities. Available literature, seeding and planting records, and practitioner surveys will be reviewed and synthesized to provide immediate guidance and to identify research needs on an ecoregional, seed zone, or plant community basis. Broad research topics will likely include factors limiting plant establishment, species interactions (among natives and native competition with nonnative weeds and forage species), and strategies for meeting challenging restoration situations, ranging from localized to landscape scales and including urban and wildland/urban interface restorations. Prioritization of needs will be completed in the first 2 years of the Strategy. However, many of the required studies will be long term and interdisciplinary, requiring collaboration among agencies, landowners, and researchers from public agencies and universities. Products will include, but not be limited to, new chemical, physical, and biological (including biocontrol and biopesticide) methods and strategies for site preparation; seeding and transplant strategies for reestablishing varied communities and habitats; and seed mix recommendations that include early colonizers and later colonizing perennials, where appropriate and effective for restoration.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, universities

Action 2.3.2 Within seed zones, investigate the capacity of native plant materials to establish and persist with invasive species, while maintaining plant diversity/function.

Native communities across the country are threatened by the encroachment of nonnative invasive species that compete with native species for resources and often preclude establishment of their seedlings. This action will facilitate research within seed zones to examine populations of native species that have undergone rapid evolution when growing within populations of nonnative annual or perennial invasive species. These native populations may have potential value as restoration material if their competitive ability is heritable and if they have not become competitive to the extent that they will preclude establishment of other native species in a seed mix. Literature reviews and surveys of researchers working in this newly evolving field will be compiled to identify potential native species and nonnative invasive combinations that may lend themselves to study for potential plant material development. The interaction of identified competitive natives with target nonnative species will be examined, and traits indicative of increased

competitive ability with target nonnatives will be identified. Assessment of the benefits and risks of competitive natives on the diversity and function of native plant communities and ecosystems will be an essential component of the research.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, universities

Action 2.3.3 Advance investigations to diversify depleted native communities to improve structure and function and to replace nonnative monocultures with native communities.

Actions will include assessing site conditions and establishing measurable objectives for restoring appropriate structure and diversity to a wide variety of plant communities that have been depleted by overgrazing, wildfires, or other disturbances at scales ranging from local to landscape. Successful restoration and ecosystem function depend on understanding site factors and native vegetation that provide critical habitat and increase sustainability. Agencies are in need of recommendations to enhance establishment and persistence of native species, including plant material recommendations, as well as seeding and planting equipment and technology for adding species to depleted native communities. Strategies are in place for some communities, but new approaches or more effective techniques are required for others. Agencies are also seeking guidance for replacing nonnative grasses that were planted on millions of acres of Federal lands. Diversifying some seedings often proves unsuccessful due to the competitiveness of the nonnatives and their ability to recover following treatments; thus, technology to improve replacement is essential. Collaborative identification of local or regional research needs should provide a basis for formulation of studies that include examination of species interactions, treatment requirements, and overall strategies for successful diversification or replacement. Research needs may be prioritized over the first 2 years, but timelines for this work will likely extend beyond the 5-year framework of this Strategy.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, NatureServe, universities

Action 2.3.4 Assess soil degradation, and develop treatments, soil amendments, and other site preparation techniques that enhance germination, establishment, and development of healthy communities capable of resisting invasion by nonnative species.

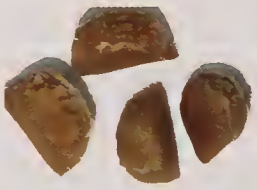
Consideration of soil condition is often not adequately incorporated into restoration planning. Addressing gaps in our understanding of soil's role in restoration will result in more successful restoration. Agencies require tools to aid in assessing site conditions (e.g., updated Natural Resources Conservation Service soil maps and ecological site descriptions) and making informed decisions regarding soil treatments, amendments, and site preparation practices. A synthesis of assessment methods and technologies to stabilize soils and improve the establishment and persistence of native species will be a starting point that will provide guidance for practitioners and identify research gaps. This synthesis can be completed within 2 years. Research will require interdisciplinary collaboration among Federal and non-Federal scientists. Outcomes will contribute to tools and training sessions described in Objective 3.

TARGET YEARS: 2015-2018
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, universities

Objective 2.4

Develop or Modify Monitoring Techniques, and Investigate Long-Term Restoration Impacts and Outcomes

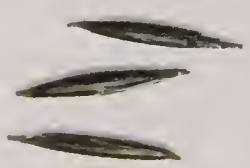
Monitoring techniques and their application vary among agencies. Techniques used to evaluate restoration projects are often modified from standard ecological monitoring methods and may or may not provide needed data, particularly for evaluating early establishment of seedings. Increased capabilities for compiling retrospective and current monitoring data from seedings into electronic databases provides an additional tool for evaluating the efficacy of standardly used plant materials and seeding techniques, the ability of seedings to meet management goals, and seeding response to environmental conditions. Actions outlined in this objective will foster needed research and enable users to evaluate past seeding mixes and techniques for meeting current goals and to obtain improved data on response of their restoration efforts.



Action 2.4.1 Analyze new and existing monitoring methodologies to evaluate restoration outcomes.

Actions in this objective will include agency analyses of current monitoring techniques for their effectiveness in evaluating the success of restoration projects over short and long time periods. An additional consideration will be the ability of these methodologies to measure progress toward meeting management priorities (e.g., establishment of pollinator habitat). Adequacies and deficiencies identified through these analyses will be synthesized at ecoregional or other appropriate scales to recommend needed research to modify existing techniques or formulate new ones. The results will provide guidelines for improved and cost-effective short- and long-term monitoring that informs restoration practices and guides ecologically robust adaptive management postseeding.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, National Institute of Food and Agriculture, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, Florida Association of Native Nurseries, Great Basin Research Center, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, NatureServe, universities



Action 2.4.2 Quantify major short- and long-term ecological and economic costs and benefits of planting native or nonnative plants on public lands (e.g., value to pollinators, biodiversity, and ecosystem functions).

Many Federal initiatives, policies, regulations, and other documents encourage the use of native species to protect native germplasm and diversity and to provide healthy, functioning ecosystems. Questions, however, remain regarding costs, establishment, competitive ability with nonnative invasives, and longevity of natives, particularly on arid and semiarid sites. Although many nonnative species have been seeded successfully and economically to provide forage and soil stabilization, their ability to support diversity and provide functioning ecosystems to meet multiple use and sustained yield mandates is limited. With improving ability to select genetically appropriate plant materials and seed diverse species, it is important for practitioners to have data available that provides guidance when planning restoration projects and selecting plant materials. This research will focus on specific systems where nonnative species are commonly used to aid in better defining alternative materials and tradeoffs resulting from plant materials decisions.

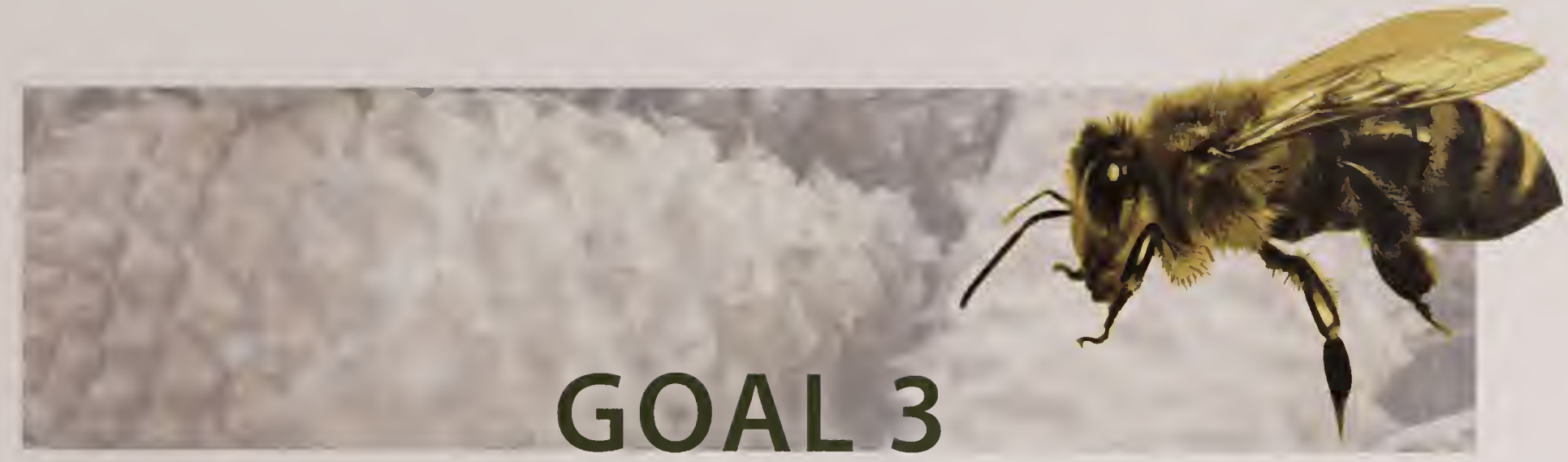
TARGET YEARS: 2016-2017
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Land Management, Department of the Interior, National Institute of Food and Agriculture, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: American Public Gardens Association, Chicago Botanic Garden, Florida Association of Native Nurseries, Institute for Applied Ecology, universities

Action 2.4.3 Conduct retrospective studies of selected native plant restoration projects to evaluate short- and long-term plant community responses to these treatments and to biotic and abiotic conditions.

This action will accelerate agency compilation of regional monitoring data from historic and current seedings as one means of evaluating agencies' current and planned restoration practices. Researchers will examine available retrospective data to evaluate short- and long-term responses of restoration projects to treatments, seed mixes, and environmental conditions to characterize variation in establishment and longevity of individual plant materials. This data will also be used to examine the role of weather conditions and other environmental variables on plant community development and ability to resist nonnative species invasions. Estimates of economic and ecological costs and benefits of restoration will be strengthened by the availability of long-term data from multiple seedings.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, Florida Association of Native Nurseries, Great Basin Research Center, Institute for Applied Ecology, universities

VOLUNTEER



GOAL 3

Develop Tools that Enable Managers to Make Timely, Informed Seeding Decisions for Ecological Restoration

Background/ Rationale

Restoration goals must be placed in the context of economic, social, and political considerations, as well as site-specific ecosystem recovery potential. In addition, managers and decisionmakers are often faced with uncertainty and having to work with incomplete information and varying availability of native plant materials. New tools are needed to help managers assess the risks, guide the scope, and predict the efficacy of restoration treatments. This would include tools that (1) help prioritize treatment locations and refine site and species-specific strategies; (2) improve mechanisms to obtain suitable native seed; and (3) determine genetically appropriate plant materials and seed zones in order to maximize restoration success in light of the most reliable short-term (10-30 year) anticipated climate changes. The use of nonlocal seed in restoration risks the movement of nonlocal genes into local populations. Potential effects must be clearly defined and disclosed so that restoration managers can make informed choices. Addressing these challenges requires syntheses of research on native species ecology and the development of tools to communicate and apply relevant knowledge. Prioritizing efforts and being responsive to emerging information on past successes and failures will help ensure that native plant communities are resilient and resistant to historical and novel stressors.

Objective 3.1

Develop Training Programs for Practitioners, Producers, and Stakeholders on the Use of Genetically Appropriate Seed for Restoration

Training programs and a certification program should be developed to promote and strengthen professional standards in all activities devoted to the use of genetically appropriate seed and ecological restoration. The training programs will increase the understanding of restoration principles, and the certification program will help evaluate the education and professional experience of restoration biologists, thus ensuring more successful restoration.

Action 3.1.1 Develop a training cadre of multidisciplinary restoration experts, and work with external partner(s) to establish a restoration practitioner certification program.

An output of this action will be a list of past and current training courses offered across agencies and restoration partners. Implementers will identify gaps between training courses offered and training needs. This should lead to resources to support costs of local or regional trainings for field managers.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: Chicago Botanic Garden, Institute for Applied Ecology

Action 3.1.2 Use and, where appropriate, expand the network of existing restoration field sites and demonstration areas.

Plan and implement the development of one to three demonstration areas per year distributed across ecoregions and provisional seed zones. Work with appropriate partners and available resources to prioritize the work.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden

Action 3.1.3 Develop resources for managers to highlight successful and unsuccessful native plant projects, including site visits.

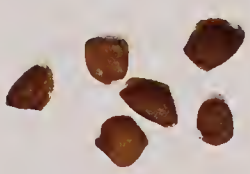
Outputs for this action may include ecoregional, interagency site visits, webinars, trainings, and other activities to inform managers on successful and unsuccessful native plant projects. Implementers will consider developing and maintaining a restoration website that is organized by ecoregion and provides one-stop shopping, including links to webinars, contacts, and resources for managers.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Institute of Food and Agriculture, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Botanic Gardens Conservation International, Institute for Applied Ecology, Mid-Atlantic Regional Seed Bank

Objective 3.2

Develop Native Seed Source Availability Data and Tools for Accessing the Data

To increase the development and use of genetically appropriate seed by Federal, tribal, state, and local agencies, as well as nongovernment partners, it will be necessary to develop national/ecoregional data, databases, and websites with seed needs and seed availability, including the identification of provisional or empirical seed zones.



Action 3.2.1 To further build local practitioner knowledge and assist their needs, support regional and nongovernmental native seed networks that provide seed with provisional and empirical seed zone origin designations.

Outputs for this action will include incorporating provisional and empirical seed zones into a national or linked series of regional databases listing commercially available native seed. Information on site of origin (e.g., soil type) will be included. This action includes work with local nonprofits. Examples could include the Native Seed Network database or NatureServe's Biotics database.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: Bureau of Land Management, Natural Resources Conservation Service, U.S. Fish and Wildlife Service
OTHER PARTICIPANTS: Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, NatureServe, New England Wild Flower Society

Action 3.2.2 Maintain a website with all available seed zone maps and publications, and develop a dynamic, web-based seed selection tool to match the seed source with the planting site.

Continuously update the U.S. Forest Service Western Wildland Environmental Threat Assessment Center's Seed Zone Mapper website with new or existing publications and maps with provisional and empirical seed zones. Maps will be provided in a variety of formats. Develop web-based tools that match seed lots with planting sites or project areas at regional or national levels.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Institute for Applied Ecology, NatureServe

Action 3.2.3 Work with partners to create a multiagency and non-Federal partner seed inventory system.

This action's output would provide updates of seed availability and a list of commercial growers and nurseries to help identify additional partners to increase native species.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: Bureau of Land Management; Natural Resources Conservation Service; U.S. Fish and Wildlife Service; U.S. Forest Service/Reforestation, Nurseries, and Genetic Resources
OTHER PARTICIPANTS: Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, NatureServe

Action 3.2.4 Develop and enhance existing Federal interagency agreement and procurement tools to facilitate multiagency seed acquisition.

This action would encourage collaboration among managers and procurement officials from Federal agencies to develop interagency agreements and procurement and agreement tools that facilitate seed acquisition between agencies. (See also Action 1.3.5)

TARGET YEARS: 2016-2018
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: To be determined

Objective 3.3

Integrate and Develop Science Delivery Tools to Support Restoration Project Development and Implementation

Ecological restoration is a science with different tools, protocols, and species that are dependent upon the ecological region where the restoration is occurring. Restoration strategies may vary from region to region. Therefore it will be necessary to work on an ecoregional basis in developing guides and techniques for practitioners to use.

Action 3.3.1 Work with Federal and state agencies, nongovernmental organizations, and other partners to identify available restoration guides and protocols by ecoregion.

Conduct a survey and assessment of ecoregional restoration guides, including native plant communities and soil types, and identify ecoregional gaps. This action will determine where ecoregional restoration guides exist and which ecoregions need guides. Further, it will lead to revision of outdated guides and preparation of guides needed to fill gaps.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Agricultural Research Service, Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Botanic Gardens Conservation International, Chicago Botanic Garden, Institute for Applied Ecology, Lady Bird Johnson Wildflower Center, Landscape Conservation Cooperatives, Mid-Atlantic Regional Seed Bank, NatureServe, New England Wild Flower Society

Action 3.3.2 Write and distribute ecoregional native plant project reports.

Develop a template for ecoregional reports. Then, develop native plant project reports using the common format (e.g., Great Basin, Colorado Plateau, Pacific Northwest, Longleaf Pine Project). Reports summarize research accomplishments, findings, and needs.

TARGET YEARS: 2016, then annually
COORDINATING AGENCIES: Bureau of Land Management, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service
OTHER PARTICIPANTS: Chicago Botanic Garden, Denver Botanic Gardens, nongovernmental organizations

Action 3.3.3 Support field implementation of restoration tools.

Develop "scientist/manager/practitioner" tools and "grower-to-grower" models of technology transfer, along with science delivery through vehicles such as the Joint Fire Science Program's Fire Science Exchange Network. To ensure these newly developed tools are used in the field, support broad distribution and delivery. These models include Federal and non-Federal partners.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: American Public Gardens Association, Chicago Botanic Garden, Lady Bird Johnson Wildflower Center, contractors, land lessees

Objective 3.4

Build on Ecological Assessments and Disturbance Data, and Provide Training that will Allow Managers to Anticipate Needs and Establish Spatially-Explicit Contingency Strategies

Managers need to evaluate their restoration projects within the context of the larger landscape to determine genetically appropriate plant materials and seed zones to maximize restoration success in light of the most reliable short-term (10-30 year) anticipated climate changes. The ecoregional context must be clearly defined and disclosed so that restoration managers can make informed choices. An ecological site description is an example of a tool that managers can use.

Action 3.4.1 Identify and inventory available climate-based geospatial tools to inform decisions regarding restoration site prioritization and methods.

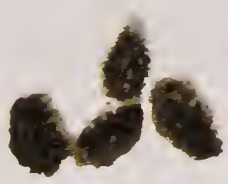
Conduct an inventory of available climate-based geospatial tools, assess their applicability, and provide access to them via appropriate websites.

TARGET YEARS: 2015
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Institute for Applied Ecology, NatureServe

Action 3.4.2 Develop a crosswalk of existing agency habitat restoration priorities and tools by provisional seed zone and plant community type.

Outputs of this action would include a list of ongoing and past efforts by agencies that prioritize habitats for restoration and conservation planning and a list of primary implementation practices and databases that are similar or different across plant communities and agencies. The lists should help managers identify needs and information gaps that could be informed by climate- and soil-based geospatial tools. Geodatabases will be developed that include information on past and current restoration activities to aid in planning future efforts.

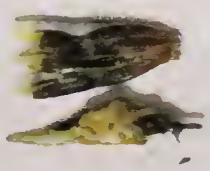
TARGET YEARS: 2015
COORDINATING AGENCIES: Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: Institute for Applied Ecology, NatureServe



Action 3.4.3 Assess climate modeling and soil/water remote sensing for their ability to forecast the likelihood of seedling establishment and persistence.

An output would be a tool linked to the Natural Resources Conservation Service's Web Soil Survey, which relates onsite soil conditions to the probability of restoration success. There is a need for a suite of tools focused on specific geographic areas or plant communities, such as resistance and resiliency science, including the Fire and Invasives Assessment Tool (FIAT) process.

TARGET YEARS: 2016 for testing; 2017 for version 1
COORDINATING AGENCIES: National Park Service, Natural Resources Conservation Service, U.S. Geological Survey
OTHER PARTICIPANTS: NatureServe



Action 3.4.4 Develop GIS-based tools for prioritizing seed needs and projects that incorporate factors, such as disturbance and climate change, into decisions.

An output of this action would be dynamic tools linked to websites, such as the U.S. Forest Service Western Wildland Environmental Threat Assessment Center's Seed Zone Mapper website.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service,

U.S. Geological Survey
OTHER PARTICIPANTS: Chicago Botanic Garden, NatureServe

Action 3.4.5 Use wildfire risk-based assessment tools to help prioritize treatment locations and refine site and species-specific strategies based on wildfire disturbance and severity.

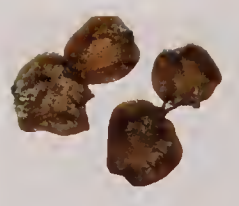
Tools will be developed to aid in analyzing site conditions post-wildfire to determine treatment needs and priorities.

TARGET YEARS: 2015-2020
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANT: NatureServe

Action 3.4.6 Develop a decision tool of belowground assessment and treatment.

Build on research identified in Goal 2 to better understand belowground ecological drivers and interactions with native plant establishment and competition with nonnative species. The tool is intended to minimize the number of potential analyses and site treatments a manager will need to consider. Initiate with literature review in 2015, and continue into 2018 as research from Goal 2 develops.

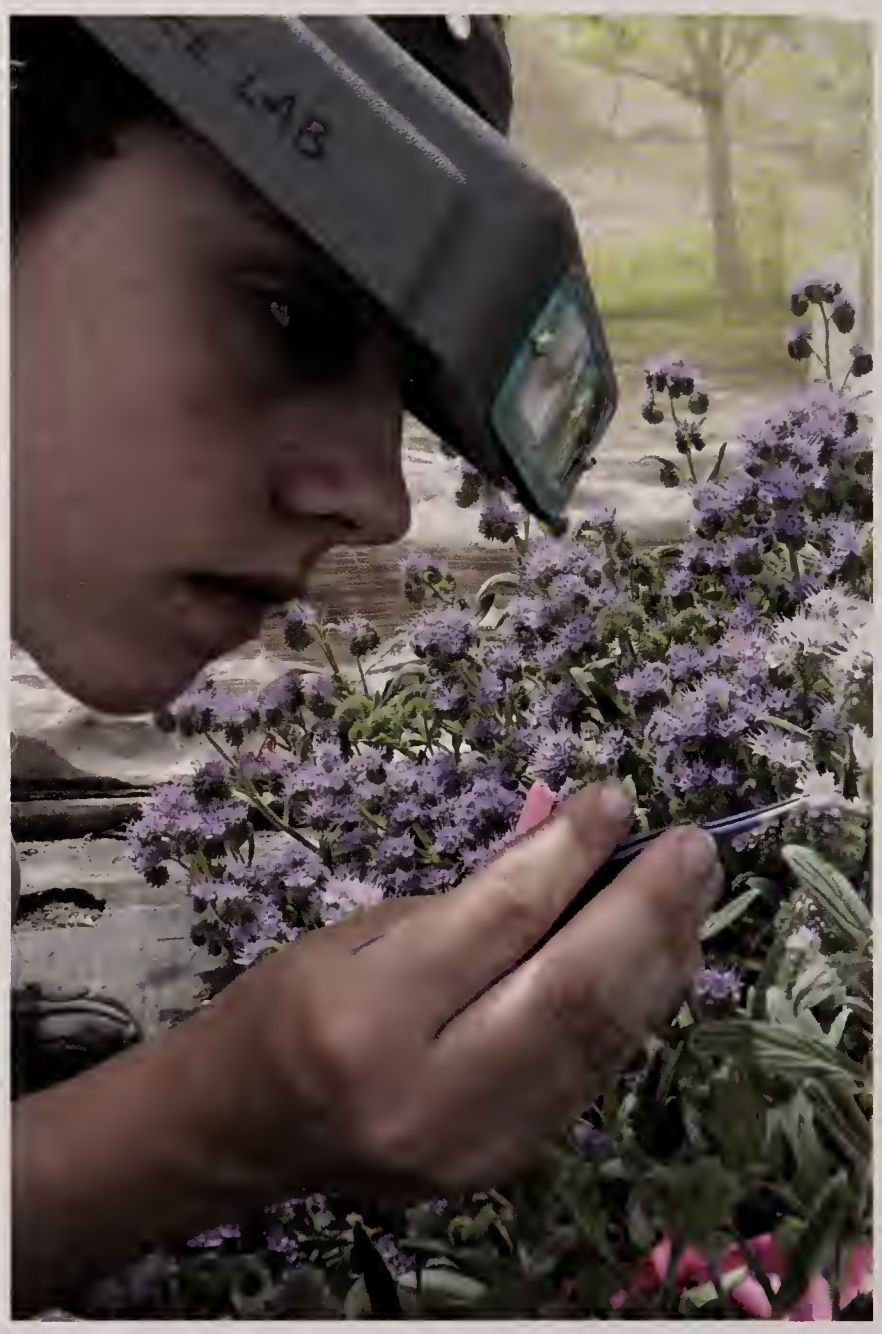
TARGET YEARS: 2015-2018
COORDINATING AGENCIES: National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey
OTHER PARTICIPANTS: To be determined

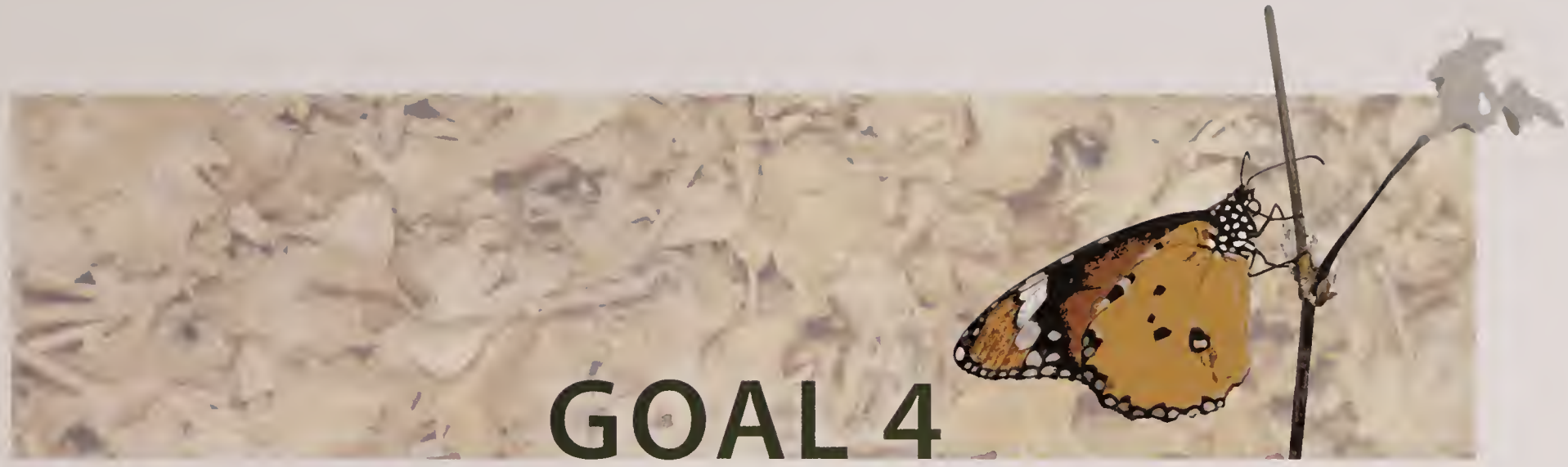


Action 3.4.7 Develop informational tools and guidelines on the appropriate use of cultivars, hybrids, and noninvasive nonnative species in limited circumstances.

This Strategy does not preclude the use of nonnative plant materials, where and when they are appropriate. Although land managers in some agencies may plant nonnative species to achieve site stabilization, wildfire breaks, or invasive plant control, the use of nonnatives should be limited to transitional, noninvasive species, replaced by natives in subsequent ecological restoration or during natural successional processes. Guidance will be developed for species effectiveness under different response scenarios, with ultimate restoration of native species.

TARGET YEARS: 2016-2020
COORDINATING AGENCIES: Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service
OTHER PARTICIPANTS: To be determined

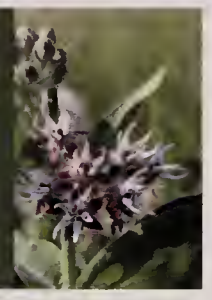




GOAL 4

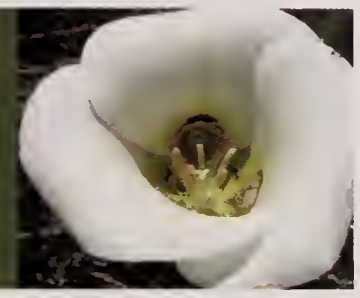
Develop Strategies for Internal and External Communication

Background/ Rationale



Successful implementation of this Strategy will require broad communication and outreach to engage agency staff and stakeholders in the shared goals of the Strategy. Both Federal and non-Federal partners play an important role in achieving the Strategy's goals. Key to implementation will be the ability to foster progress as a collaborative multiagency effort. Communications should be tailored to key audiences, including agency partners, collaborators, other stakeholders, and interested publics. Following a national, coordinated rollout, each agency will take steps to incorporate actions into their own policies and programs and communicate with their key stakeholders. Each agency will report progress on Strategy implementation to leadership and other Strategy participants. An emphasis on feedback, evaluation, and improvement of the Strategy will help ensure it remains relevant and responsive to evolving needs. And finally, success stories, lessons learned, and recommendations for improvements should be highlighted in communications products and materials.

Objective 4.1



External Communications: Conduct Education and Outreach through the Plant Conservation Alliance Network

The importance of this Strategy and the significant role of collaboration in meeting the Strategy's goals should be shared with a broad audience and incorporated into partner communications and materials, as appropriate.

Action 4.1.1 Develop a communications plan, including goals, target audiences, and key messages.

Working together, the agencies and partners should develop and implement a broad communications plan that outlines how the Strategy will be promoted within and outside of partner organizations. The communications plan would define communication goals, audiences, and key messages that would influence the development of appropriate communication products or methods. Each agency would then develop an agency-specific communications approach to implement the plan.

TARGET YEAR: 2015
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration, Smithsonian Institution
OTHER PARTICIPANTS: Botanic Gardens Conservation International, Lady Bird Johnson Wildflower Center, PCA cooperators

Action 4.1.2 Involve the Plant Conservation Alliance in communications for the Strategy.

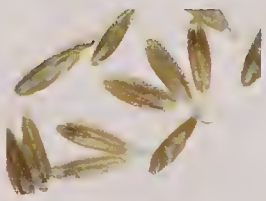
Including the Strategy as a focus of the PCA annual meetings and adding the Strategy as a standing agenda item on bimonthly webinar meetings will provide important opportunities to share expertise and highlight key information needs. The PCA website and email distribution list are effective vehicles for connecting with collaborating institutions and the public. Efforts should be made to increase participation of agencies and partners currently not yet involved in the PCA. The PCA Steering Committee for the Strategy is a source of expertise on issues pertaining to using and developing native plant materials and can help identify resources, information, and additional expertise as needed. The PCA expertise comes from a broad spectrum of botanical, horticultural, agronomic, and species experts.

TARGET YEARS: Ongoing
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration, Smithsonian Institution
OTHER PARTICIPANTS: American Public Gardens Association, Botanic Gardens Conservation International, cooperators

Objective 4.2

Internal Communications: Distribute and Implement the Strategy Across Agencies, and Provide Feedback Mechanisms

Internal communication within the agencies will ensure that appropriate staff members are given opportunities to become fully informed about the Strategy and its relevance to their work. Greater awareness of the Strategy within the agencies will also enhance collaboration and facilitate linkages between the Strategy and related agency initiatives.



Action 4.2.1 Develop internal communications plans.

Federal partners will develop internal communication plans to increase awareness and facilitate implementation of the Strategy. Plans will incorporate the key messages developed in Action 4.1.1 and describe how the Strategy supports the agency mission and national initiatives, such as climate change, invasive species, and pollinator initiatives. Internal communications should consider key programmatic areas that will be contributing to or benefiting from information, training, and products emanating from the Strategy.

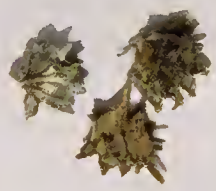
TARGET YEARS: 2015
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined

Action 4.2.2 Identify and use communication mechanisms for implementing the Strategy.

Each agency will coordinate its own implementation plan for the Strategy, as it pertains to agency initiatives and objectives. Outputs may include instruction memoranda, policy directives, native plant policies, information bulletins, and handbooks. Agencies should identify key programmatic and field contacts and networks to assist in implementing the Strategy and appropriate channels for reporting progress within their agency (to inform Action 4.3.1).

TARGET YEARS: Ongoing
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration

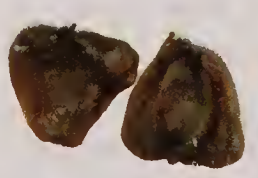
OTHER PARTICIPANTS: Applied Ecological Services/Taylor Creek Restoration Nurseries, Lady Bird Johnson Wildflower Center, PCA cooperators



Action 4.2.3 Make existing agency native plant policies available to the public.

This action aims to collate agency policies and guidance on the use of native plant materials and provide them in a web-based format to make policies and guidance more accessible to Strategy collaborators and other interested parties. Several actions under Goals 1, 2, and 3 of this Strategy may inform this deliverable. Content should also be incorporated into the PCA Federal member agency interface webpages, which link to each Federal member's website on the PCA website. This action may require assistance from appropriate agency outreach and technical web experts.

TARGET YEARS: 2015
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined



Action 4.2.4 Incorporate the Strategy's goals and key messages into appropriate existing landscape-scale restoration initiatives.

Many ongoing restoration activities encompass the aims of the Strategy. Incorporating goals and

key messages into those relevant initiatives will facilitate collaboration and set the stage for feedback mechanisms to inform the Strategy.

TARGET YEARS: 2016
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: Lady Bird Johnson Wildflower Center

Objective 4.3

Report Progress, Recognize Achievements, and Revise Strategy

Actions under this objective will encourage two-way communication and feedback and raise the visibility of restoration efforts that result from actions outlined in the Strategy. Planning for progress, achievements, and revisions to the Strategy will help ensure that the goals remain relevant.

Action 4.3.1 Establish a mechanism to report on the progress achieved through the Strategy, including successful native plant projects and lessons learned.

Under this action, PCA annual meetings could provide a feedback mechanism for collaborators to report achievements. This could facilitate production of an annual report to track progress on the Strategy for use and analysis in 5-year progress measures and future directions. Agencies will have identified appropriate channels for reporting progress within their agency, and data calls might coincide with the end of the fiscal year with a goal of providing information early the following year (e.g., by February 1). The agency communication plans might also include as deliverables the training, collaboration, and technology transfer objectives of the other goals in this Strategy (e.g., see Goal 3, in particular).

TARGET YEAR: 2015
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined

Action 4.3.2 Recognize and promote achievements made and improvements needed in implementing the Strategy across all agencies and partners.

This action would promote successes as well as elicit recommendations for improvement and future direction. Recognition is achieved through a number of venues, such as new or existing award programs—potentially through the PCA—press events, articles, etc.

TARGET YEARS: 2016 and beyond
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined

Action 4.3.3 Review and revise the Strategy every 5 years or as needed.

This action will result in a dynamic Strategy, with actions that evolve and are endorsed by agency leaders through the PCA. To implement this action, consider prospects for revisions to be made as needed, timing, and other considerations for revisions when the PCA federal memorandum of understanding is renewed.

TARGET YEARS: Ongoing
COORDINATING AGENCIES: Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Bureau of Indian Affairs, U.S. Forest Service, National Institute of Food and Agriculture, Agricultural Research Service, Natural Resources Conservation Service, Federal Highway Administration
OTHER PARTICIPANTS: To be determined

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- Bureau of Indian Affairs
- Bureau of Land Management
- Federal Highway Administration
- National Institute of Food and Agriculture
- National Park Service
- Natural Resources Conservation Service
- Smithsonian Institution
- United States Botanic Garden
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Geological Survey

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GLOSSARY

This glossary describes terms referenced in the "National Seed Strategy for Rehabilitation and Restoration." These terms are defined with the intent of providing clarity for their use in this Strategy. These terms may have been previously described by Federal agencies or professional societies or in scientific literature; however, the terms may have been modified to meet the purposes of this document. Sources include: Aubry et al. (2005), Bower et al. (2014), Havens et al. (2015), Kramer et al. (2015), NFWPCAP (2012), NISC (2006), SER (2004), USDI BLM (2009), and U.S. Forest Service (2008).

adaptation (adapted): a change or the process of change in structure or habits by which a species or organism becomes better suited to its environment.

common garden study: an experiment where different genotypes, populations, or varieties are grown together in the same environment such that environmental effects on trait expression are minimized and genetic differences are more readily observed.

ecological genetics: the study of how ecologically relevant traits evolve in natural populations.

ecology: the study of relationships of organisms to one another and their environments.

ecological restoration: See restoration in glossary.

ecoregion: areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components.

ecosystem: the biota (plants, animals, microorganisms) within a given area, the environment that sustains it, and their interactions.

ecosystem services: the benefits people and wildlife obtain from ecosystems. These include provisioning services such as food, water, timber, pollination, and fiber; regulating services such as the regulation of climate, floods, disease, wastes, and water quality; cultural services such as recreation, aesthetic enjoyment, identity, and spiritual fulfillment; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

empirical seed zone: empirical seed zones are developed for individual species across their distribution through the following steps: (1) Researchers collect seed from diverse geographic and climatic areas of the targeted region; (2) Researchers evaluate plantings from collected seeds in common gardens for production, morphology, phenology, and physiological traits; (3) Researchers develop regression models that link genetic variation across the landscape with collection location environments to delineate seed zones for the collected species. (See also provisional seed zone in glossary.)

establishment: the stage at which the seedling has exhausted the food reserves stored in the seed and must grow, develop, and persist independently.

ex situ conservation: the technique of conserving all levels of biological diversity outside their natural habitats through such means as botanical gardens, zoos, or seed banks.

gene flow: the transfer of alleles or genes from one population to another.

genetically appropriate plant materials: native plant materials environmentally adapted to a restoration site that are likely to establish,

persist, and promote community and ecological relationships. Such plants would be: sufficiently genetically diverse to respond and adapt to changing climates and environmental conditions; unlikely to cause genetic contamination and undermine local adaptations, community interactions, and function of resident native species within the ecosystem; not likely to become invasive and displace other native species; not likely to be a source of nonnative invasive pathogens; and likely to maintain critical connections with pollinators.

genotype: the genetic makeup of a cell, an organism, or an individual. The genetic code of an organism.

germination: events beginning with water uptake by a seed and ending with the beginning of elongation of the embryonic axis through the surrounding structures.

habitat: the dwelling place of an organism or community that provides the requisite conditions for its life processes.

invasive species: a species that is nonnative to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.

locally adapted plants: plants from an area geographically near a planting site that are environmentally adapted and likely to establish and persist.

maladaptation: a species that has traits that are poorly suited or adapted to a particular situation or set of conditions.

native plants: indigenous terrestrial and aquatic species that have evolved and occur naturally in a particular region, ecosystem, or habitat. Species native to North America are generally recognized as those occurring on the continent prior to European settlement. Native plant species represent a number of different life forms, including conifer trees, hardwood trees and shrubs, grasses, forbs, and others.

native plant communities: recurring assemblages of native plant species associated with local substrates and natural dynamic processes. Their composition varies in space and time in response to changes in climate and species dispersal.

nonnative species: an organism is considered nonnative (alien, foreign, nonindigenous, exotic) when it has been introduced by humans to a location(s) outside its native or natural range. This designation applies to a species introduced from another continent, another ecosystem, another seed zone, and even another habitat within an ecosystem. With respect to a particular ecosystem, this includes any species, including its seeds, eggs, spores, or other biological material, capable of propagating that species, that is not native to that ecosystem. This definition of nonnative will vary depending on the scope and context of projects.

protocol: a standardized method containing detailed steps.

provisional seed zone: provisional seed zones are based on climate data and used for species for which empirical seed zones have not been developed. Provisional seed zones in combination with established ecoregions can be used to guide movement of plant materials for restoration. (See also empirical seed zone in glossary.)

reciprocal transplant studies: studies using plants from multiple populations of a species that are planted in a set of sites that represent local and nonlocal climates to test questions of adaptation of the populations to their local environments. Such studies are useful for evaluating the effectiveness of seed transfer guidelines and seed zones. When sites represent extreme environments, these studies have been used effectively to predict how plants will respond to future climate change as climates shift toward new extremes.

reclamation: actions to stabilize the terrain, assure public safety, improve aesthetics, and usually to return the land to what, within the regional context, is considered to be a useful purpose. Reclamation projects that are more ecologically based can qualify as rehabilitation or even restoration.

rehabilitation: rehabilitation emphasizes the reparation of ecosystem processes, productivity, and services, whereas the goals of restoration also include the reestablishment of the preexisting

biotic integrity in terms of species composition and community structure.

resilience: the degree to which an ecosystem is able to regain structural and functional attributes after it has suffered harm from stress or disturbance.

restoration: the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

seed reserve: a national network of storage facilities for seed that can be used by land managers for restoration projects. Seed reserves will include seeds of pollinator-friendly plants.

seed transfer guidelines: recommendations for protecting the integrity of the natural pattern of adaptive variation of wild populations by restricting seed transfer to areas within which seed can be moved about freely with the expectation that they will grow and reproduce successfully and will produce no adverse genetic effects.

seed zone: a mapped area with fixed boundaries in which seeds or plant materials can be transferred with minimal risk of maladaptation.

stabilization: to determine the need for and to prescribe and implement emergency treatments to minimize threats to life or property or to stabilize and prevent unacceptable degradation to natural and cultural resources resulting from the effects of disturbances.

stakeholder: individuals, organizations, and intergovernmental partners who are involved in or contribute valuable knowledge to and support for implementing the actions outlined in this Strategy, or who may be directly or indirectly impacted by the actions of the Strategy. Those who have an interest in the Strategy's outcome.

treatment: an action or actions taken to ameliorate or repair ecosystem damage. These activities vary with objectives but occur along the repair continuum, which includes restoration, rehabilitation, and reclamation.

workhorse species: species that are locally adapted native plants that are abundant across a wide range of ecological settings, establish quickly, and produce high ground cover on disturbed sites.

APPENDIX

Action Summary Tables

Organization Acronyms

Name	Acronym
Agricultural Research Service (USDA)	ARS
American Public Gardens Association	APGA
American Seed Trade Association	ASTA
Applied Ecological Services/Taylor Creek Restoration Nurseries	AES/TCRN
Botanic Gardens Conservation International	BGCI
Bureau of Indian Affairs (DOI)	BIA
Bureau of Land Management (DOI)	BLM
Chicago Botanic Garden	CBG
Connecticut Department of Energy and Environmental Protection	CTDEEP
Denver Botanic Gardens	DBG
Department of the Interior (DOI Plant Conservation Alliance MOU signatory agencies)	DOI
Federal Highway Administration	FHWA
Florida Association of Native Nurseries	FANN
Forest Service (USDA)	USFS
Great Basin Research Center	GBRC
Institute for Applied Ecology	IAE

Name	Acronym
Landscape Conservation Cooperatives	LCC
Mid-Atlantic Regional Seed Bank	MARS-B
National Institute of Food and Agriculture (USDA)	NIFA
National Park Service (DOI)	NPS
Natural Resources Conservation Service (USDA)	NRCS
NatureServe	NS
New England Wild Flower Society	NEWFS
Nongovernmental organization	NGO
Plant Conservation Alliance	PCA
Reforestation, Nurseries, and Genetic Resources	RNGR
Seeds of Success	SOS
Smithsonian Institution	SI
U.S. Fish and Wildlife Service (DOI)	USFWS
U.S. Geological Survey (DOI)	USGS
U.S. Department of Agriculture (USDA Plant Conservation Alliance MOU signatory agencies)	USDA
Utah Department of Natural Resources	Utah DNR

Note: While the "National Seed Strategy for Rehabilitation and Restoration" will be renewed in 5-year cycles, its actions will affect landscapes and habitats far into the future. The agencies and other participants listed in this document are current as of this printing, but additional participation is encouraged and welcomed.

GOAL 1 Summary Tables
Identify Seed Needs, and Ensure the Reliable Availability of Genetically Appropriate Seed

Objective 1.1: Assess the Seed Needs of Federal Agencies and the Capacity of Private and Federal Producers

Action	Coordinating Agencies	Other Participants	Target Years
1.1.1 Conduct an assessment of seed needs for all Federal agencies and their offices that provide or use seed.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS	CTDEEP	2015-2016
1.1.2 Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS	CTDEEP	2015-2016
1.1.3 Identify existing federal seed and restoration policies and guidance.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	2015-2020
1.1.4 Analyze results of needs and capacity assessment to determine if agencies' needs are met.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	IAE	2016-2017
1.1.5 Analyze results of policy and guidance assessment and develop restoration program.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS	NS	2017-2018

Objective 1.2: Assess Capacity and Needs of Tribes, States, Private Sector Seed Producers, Nurseries, and Other Partners

Action	Coordinating Agencies	Other Participants	Target Years
1.2.1 Conduct a needs and capacity assessment of tribal, state, local, private sector, and nonprofit seed storage and distribution facilities.	BIA, NRCS	ASTA, BGCI, FANN, LBJWC, MARS-B, NEWFS	2015-2020
1.2.2 Work with partners to leverage strengths and address deficiencies in distribution and availability of genetically appropriate seed.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS	AES/TCRN, ASTA, BGCI, FANN, IAE, LBJWC, MARS-B, NS	2015-2020
1.2.3 Analyze results of needs and capacity assessment.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	BGCI, IAE, LBJWC	2016-2017

Objective 1.3: Increase the Supply and Reliable Availability of Genetically Appropriate Seed

Action	Coordinating Agencies	Other Participants	Target Years
1.3.1 Expand and improve facilities and plant production capacity.	BIA, BLM, NIFA, NPS, NRCS, USFS, USFWS	ASTA, CBG, FANN	2015-2020
1.3.2 Improve capability to plan for seed needs by seed zone.	BIA, BLM, NIFA, NPS, NRCS, USFS, USFWS	CBG, FANN, MARS-B, NEWFS	2015-2020
1.3.3 Assess and implement alternative seed production methods for "workhorse" shrub species.	BLM, NIFA, NPS, USFS, USFWS	CBG, LBJWC	2015-2020
1.3.4 Expand collection, conservation, and assessment of native plant genetic resources through programs such as SOS.	ARS, BLM, NIFA, NPS, NRCS, SI, USFS, USFWS	APGA, BGCI, CBG, DBG, LBJWC, NS	2015-2020
1.3.5 Engage Federal procurement specialists to assess contracting regulations and practices; correct deficiencies.	BLM, NIFA, NPS, USFS, USFWS	ASTA, FANN, IAE, MARS-B	2015-2017

GOAL 2 Summary Tables
Identify Research Needs and Conduct Research to Provide Genetically Appropriate Seed and to Improve Technology for Native Seed Production and Ecosystem Restoration

Objective 2.1: Characterize Genetic Variation of Restoration Species to Delineate Seed Zones, and Provide Seed Transfer Guidelines for Current and Projected Future Environmental Conditions

Action	Coordinating Agencies	Other Participants	Target Years
2.1.1 Conduct genetic research to develop seed zones for key restoration species.	BLM, NIFA, NRCS/Plant Materials Centers, USFS, USFWS, USGS	BGCI, CBG, DBG, GBRC, IAE, LBJWC, MARS-B, NEWFS, NS, Utah DNR, universities	2015-2020
2.1.2 Develop predictive models of climate change effects.	NIFA, USFS, USGS	APGA, CBG, IAE, NS, universities	2016-2020

Objective 2.2: Conduct Species-Specific Research to Provide Seed Technology, Storage, and Production Protocols for Restoration Species

Action	Coordinating Agencies	Other Participants	Target Years
2.2.1 Conduct seed germination studies and develop seed testing protocols for key restoration species.	ARS, BLM, NIFA, USFS, USFWS, USGS	CBG, DBG. GBRC, IAE, LBJWC, private seed testing labs and seed companies, state seed laboratories, universities	2015-2020
2.2.2 Develop storage guidelines for key restoration species to improve maintenance of seed viability.	ARS, BLM, NIFA, USFS, USGS	CBG, DBG, GBRC, private seed testing labs and seed companies, state seed laboratories, universities, Utah DNR	2015-2020
2.2.3 Develop species-specific protocols for seed and seedling production practices to maintain genetic diversity.	BLM, NIFA, NRCS, USFS, USFWS, USGS	CBG, GBRC, IAE, LBJWC, public and private seed producers and nurseries, state agencies, universities	2015-2020

Objective 2.3: Conduct Research on Plant Establishment, Species Interactions, and Ecological Restoration

Action	Coordinating Agencies	Other Participants	Target Years
2.3.1 Develop site preparation and seeding and transplanting strategies that improve plant establishment and diversity.	ARS, BLM, NIFA, USFS, USFWS, USGS	CBG, DBG. GBRC, IAE, LBJWC, universities	2015-2020
2.3.2 Within seed zones, examine capacity of native plants to establish and persist.	ARS, BLM, NIFA, USFS, USFWS, USGS	CBG, GBRC, IAE, LBJWC, universities	2015-2020
2.3.3 Advance investigations to diversify depleted native communities.	ARS, BLM, NIFA, NPS, USFS, USFWS, USGS	CBG, GBRC, IAE, LBJWC, NS, universities	2015-2020
2.3.4 Assess soil degradation, and develop treatments, soil amendments, and other site preparation techniques.	ARS, BLM, NIFA, NPS, USFS, USFWS, USGS	CBG, GBRC, IAE, LBJWC, universities	2015-2018

Objective 2.4: Develop or Modify Monitoring Techniques, and Investigate Long-Term Restoration Impacts and Outcomes

Action	Coordinating Agencies	Other Participants	Target Years
2.4.1 Analyze new and existing monitoring methodologies to evaluate restoration outcomes.	ARS, BLM, NIFA, NRCS, USFS, USFWS, USGS	CBG, DBG, FANN, GBRC, IAE, LBJWC, NS, universities	2015-2020
2.4.2 Quantify ecological and economic costs/benefits of planting native and nonnative plants on public lands.	ARS, BLM, DOI, NIFA, NPS, USFS, USFWS, USGS	APGA, CBG, FANN, IAE, universities	2016-2017
2.4.3 Study selected native plant restoration projects to evaluate short- and long-term responses.	BLM, NIFA, NPS, NRCS, USFS, USFWS, USGS	CBG, DBG, FANN, GBRC, IAE, universities	2015-2020

GOAL 3 Summary Tables
Develop Tools that Enable Managers to Make Timely, Informed Seeding Decisions for Ecological Restoration

Objective 3.1: Develop Training Programs for Practitioners, Producers, and Stakeholders on the Use of Genetically Appropriate Seed for Restoration

Action	Coordinating Agencies	Other Participants	Target Years
3.1.1 Develop a cadre of experts, and work with partners to establish a restoration certification program.	BIA, BLM, FHWA, NIFA, NPS, NRCS, USFS, USFWS	CBG, IAE	2016-2020
3.1.2 Use and, where appropriate, expand the network of restoration field sites and demonstration areas.	BIA, BLM, NIFA, NPS, NRCS, USFS, USFWS, USGS	CBG	2015-2020
3.1.3 Develop resources for managers to highlight successful/unsuccessful projects, including site visits.	BIA, BLM, FHWA, NIFA, NPS, NRCS, USFS, USFWS, USGS	BGCI, IAE, MARS-B	2015-2020

Objective 3.2: Develop Native Seed Source Availability Data and Tools for Accessing the Data

Action	Coordinating Agencies	Other Participants	Target Years
3.2.1 Support regional/nongovernmental native seed networks that provide seed with seed zone origin.	BLM, NRCS, USFWS	IAE, LBJWC, NEWFS, NS	2016-2020
3.2.2 Maintain a website with seed zone maps and publications, and develop a web-based seed selection tool to match seed source/planting site.	USFS, USGS	IAE, NS	2016-2020
3.2.3 Create a multiagency and non-Federal partner seed inventory system.	BLM, NRCS, USFS/RNGR, USFWS	IAE, LBJWC, NS	2016-2020
3.2.4 Develop/enhance Federal agreement/procurement tools for multiagency seed acquisition.	BIA, BLM, FHWA, NPS, USFS, USFWS	To be determined	2016-2018

Objective 3.3: Integrate and Develop Science Delivery Tools to Support Restoration Project Development and Implementation

Action	Coordinating Agencies	Other Participants	Target Years
3.3.1 Identify available restoration guides and protocols by ecoregion.	ARS, BIA, BLM, FHWA, NPS, NRCS, USFS, USFWS, USGS	BGCI, CBG, IAE, LBJWC, LCC, MARS-B, NEWFS, NS	2015-2020
3.3.2 Write and distribute ecoregional native plant project reports.	BLM, NPS, NRCS, USFS, USFWS	CBG, DBG, NGO	2016 and after
3.3.3 Support field implementation of restoration tools.	BIA, BLM, FHWA, NPS, NRCS, USFS, USFWS, USGS	APGA, CBG, LBJWC, contractors, land lessees	2016-2020

Objective 3.4: Build on Ecological Assessments and Disturbance Data, and Provide Training that will Allow Managers to Anticipate Needs and Establish Spatially-Explicit Contingency Strategies

Action	Coordinating Agencies	Other Participants	Target Years
3.4.1 Identify/inventory climate-based geospatial tools to inform decisions on restoration site priority/methods.	BIA, BLM, FHWA, NPS, NRCS, USFS, USFWS, USGS	IAE, NS	2015
3.4.2 Develop crosswalk of agency habitat restoration priorities/tools by provisional seed zone and plant community.	BIA, BLM, FHWA, NPS, NRCS, USFS, USFWS, USGS	IAE, NS	2015
3.4.3 Assess climate modeling and soil/water remote sensing to forecast seedling establishment and persistence.	NPS, NRCS, USGS	NS	2016 for testing; 2017 for version 1
3.4.4 Develop GIS-based tools with disturbance data for prioritizing seed needs/projects.	BLM, USFS, USFWS, USGS	CBG, NS	2015-2020
3.4.5 Use risk-based assessment tools to prioritize treatment locations and refine strategies based on wildfire.	BLM, USFS, USGS, USFWS	NS	2015-2020
3.4.6 Develop a decision tool of belowground assessment and treatment.	NPS, NRCS, USFS, USFWS, USGS	To be determined	2015-2018
3.4.7 Develop informational tools and guidelines on the appropriate use of cultivars, hybrids, and noninvasive nonnative species.	BLM, NPS, USFWS	To be determined	2016-2020

GOAL 4 Summary Tables
Develop Strategies for Internal and External Communication

Objective 4.1: External Communications: Conduct Education and Outreach through the Plant Conservation Alliance Network

Action	Coordinating Agencies	Other Participants	Target Years
4.1.1 Develop a communications plan.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA, SI	BGCI, LBJWC, PCA cooperators	2015
4.1.2 Involve the Plant Conservation Alliance in communications.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA, SI	APGA, BGCI, PCA cooperators	Ongoing

Objective 4.2: Internal Communications: Distribute and Implement the Strategy Across Agencies, and Provide Feedback Mechanisms

Action	Coordinating Agencies	Other Participants	Target Years
4.2.1 Develop internal communications plans.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	2015
4.2.2 Identify and use communication mechanisms for implementing the Strategy.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	AES/TCRN, LBJWC, PCA cooperators	Ongoing
4.2.3 Make existing agency native plant policies available to the public.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	2015
4.2.4 Incorporate Strategy goals and key messages into landscape-scale restoration initiatives.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	LBJWC	2016

Objective 4.3: Report Progress, Recognize Achievements, and Revise Strategy

Action	Coordinating Agencies	Other Participants	Target Years
4.3.1 Establish mechanism to report progress, including successful native plant projects and lessons learned.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	2015
4.3.2 Recognize/promote achievements/needed improvements across all agencies and partners.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	2016 and beyond
4.3.3. Review and revise the Strategy every 5 years or as needed.	BLM, USFWS, NPS, USGS, BIA, USFS, NIFA, ARS, NRCS, FHWA	To be determined	Ongoing

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